GRT SPORT

User's Guide and Reference

Rev. B
3-23-07

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Revision Level	Change Summary
B	**Extensive additions**

Revision	Date of Revision	Change(s)
A	11-27-06	First Release
B	4-1-07	Extensive

Manual conventions

This bar in the margin indicates an item has been updated or changed from the previous release.

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Visit the Grand Rapids Technologies (GRT) website for the latest updates and supplemental information concerning the operation of this and other GRT products.

NOTE: This manual is incomplete at this time. Most, but *not all* data contained within is accurate. This manual reflects the operation of software version 2b or later. Some differences may be observed when comparing the information in this manual to other software versions.

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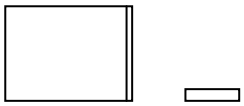
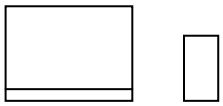
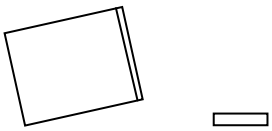
NOTE: Magnetometer and Display Unit with ADAHRS must be mounted in same attitude relative to each other.



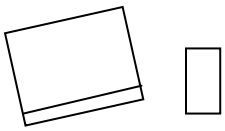
Side View – Correct



Top View- Correct



Side View – Incorrect



Top View - Incorrect

WARNING: Obstacle clearance is not assured in Synthetic Approach Mode.

WARNING: Various functions of this system may be incomplete, or untested. Please exercise caution when using the EFIS until a software update and a user manual corresponding to the software version are provided.

CAUTION: If any display unit is inoperable, the display units will not be able to swap information. The pilot must account for this down-graded mode of operation and expect data will not transfer between displays.

CAUTION: If GPS position data is lost for more than 30 seconds, the EFIS Sport issues a **No GPS Position** warning, and automatically reverts to dead-reckoning using the AHRS heading, true airspeed, and last known winds, and time. This data is used to estimate changes in position, which are applied to the last known GPS position, to give an approximate navigation solution. The accuracy of the dead-reckoning function will degrade with time depending on the accuracy this data and changes in the winds.

CAUTION: When the ground track indicator is hollow, indicating it is display-limited; the ground track indicated is necessarily inaccurate. This means that the aircraft's track over the ground is not as indicated, and the pilot should be aware of this inaccuracy with regard to obstacle and terrain clearance.

NOTE: Serial Port 4 is a high speed port and is for the GRT Weather module if the weather option is used.

SECTION 1: INTRODUCTION

Welcome to Grand Rapids Technologies' GRT Sport! In this first section we will cover the Standard Sport package, powering the Sport, and give an overview of the different display group pages.

1.1 Accessories and Packing List

Before installing the GRT Sport, please check to see that the package includes the following items. If any parts are missing or damaged, please contact GRT, Inc. or your GRT, Inc. dealer immediately.

Standard Package

Multi-Function Display (MFD) Unit with internal Attitude, Heading Reference System (AHRS) and Air Data Computer
Magnetometer
Wiring Harness
USB Memory Stick
User's Guide and Reference Manual
Installation Manual

Multi -Display Package

In addition to the standard package, multiple display unit packages contain:

Additional display unit(s)
Engine Information System (EIS) Computer
Four (4) Exhaust Gas Temperature (EGT) Probes
Four (4) Cylinder Head Temperature (CHT) Probes
Oil Temperature Probe
Oil Pressure Probe

NOTE: The current software version comes installed from GRT, Inc. Any product or software updates can be found on the Grand Rapids Technologies, Inc. website at www.grtavionics.com

1.2 Ground Power Up

The GRT Sport will turn on once power is supplied.

When an Aircraft On Ground (AOG) power-up occurs the startup screen will show software and navigation database version and GRT system status.

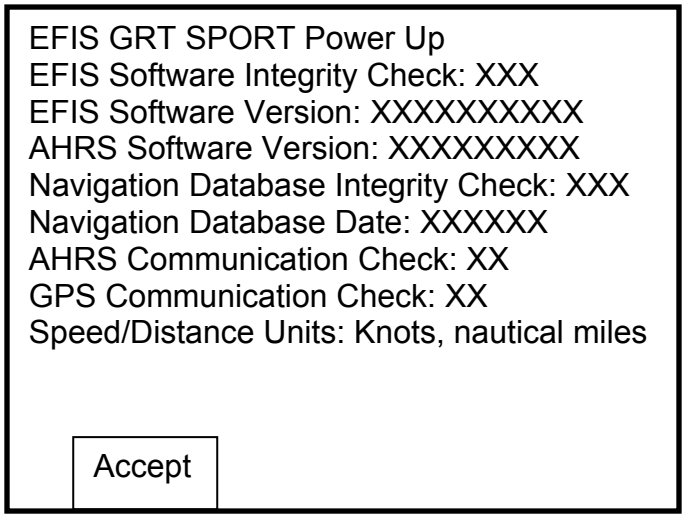

EFIS GRT SPORT Power Up
EFIS Software Integrity Check: XXX
EFIS Software Version: XXXXXXXXXX
AHRS Software Version: XXXXXXXXX
Navigation Database Integrity Check: XXX
Navigation Database Date: XXXXXX
AHRS Communication Check: XX
GPS Communication Check: XX
Speed/Distance Units: Knots, nautical miles
Accept

Fig. 1-1 Startup Screen

To acknowledge the database information:
Press the button labeled **ACCEPT**

Once acknowledged the default screen appears per the user's preset selection.

Note: The factory default screen is the Primary Flight Display (PFD).

1.3 In-flight Power Up

An In-Flight power-up occurs when the following is true:

- *Airspeed greater than 50 mph and/or GPS-reported ground-speed greater than 25 mph.*

An In-Flight power-up will result in the display unit showing the same screen as was selected when the display unit was last powered down. The startup screen will not show.

1.4 Attitude Heading Reference System (AHRS)

The AHRS is subject to an angular rate maximum of 200 deg/second. If this limit is exceeded, the **AHRS Unreliable** message will be displayed. The air data (airspeed and altimeter) will remain valid however, attitude data will not be.

The AHRS may take up to 180 seconds to align during initial startup. During this time the aircraft should remain motionless. The **Align** message will show on the screen with the time remaining for alignment.

Fig. 1-2 Labels

1.5 Knobs and Buttons

The GRT Sport system is designed to make its use and operation simple. The left and right knobs and five white buttons are used to access the many features in the EFIS. Menu option labels show functions for each knob and button.

Knobs

The two knobs have two motions, rotary and push. These provide particular functions on different pages. (The knobs may also be called rotary encoders.)

Buttons

There are five buttons. Pressing any button will display the corresponding menu options for that page. (The buttons may also be called SoftKeys. They correspond to particular software functions within the GRT Sport.)

Menu Option Labels

Labels are blue boxes over the knobs or buttons and describe the function for that page.

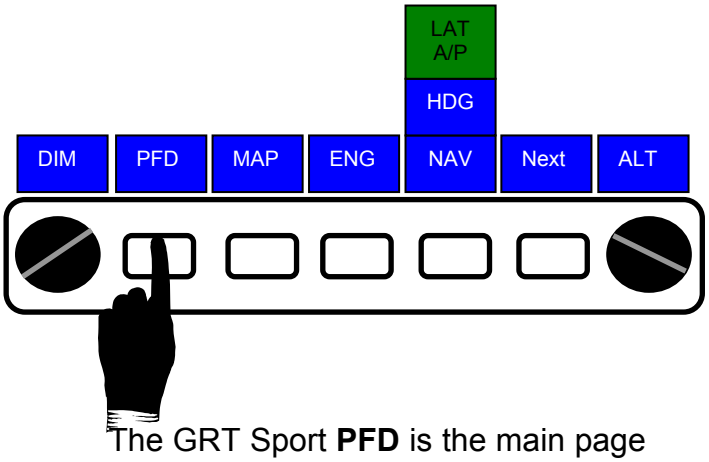
Labels appear when a knob or button is pressed and disappear after 4 seconds, unless another knob or button is turned or pressed.

The selected or active feature is in a white border whilel others are within a black border.

Section 2: Multi-Function Display

2.1 Primary Flight Display Group

Within the **PFD** group are selectable pages. By using the **PFD** labeled button you may select the PFD page or 3 split pages; PFD/MAP Arc, PFD/HSI, and PFD/Engine.



The GRT Sport **PFD** is the main page used during flight. It consists of the basic six indicators including the following:

- Artificial Horizon
- Airspeed Tape & Indicator
- Altimeter Tape & Indicator
- Turn Coordinator
- Vertical Speed Indicator
- Heading Indicator
- User Definable Fields
- Heading Select Display
- Flight Track Marker
- Baroset Select Display
- GPS CDI Display
- Wind Indicator
- Ground Track and Waypoint Bearing Indicators
- Flight Path Marker
- Artificial Runways

Fig. 2-1 PFD Screen

FIG. 2-2 PFD/MAP Arc

FIG. 2-3 PFD/CDI

Fig. 2-4 PFD/Engine

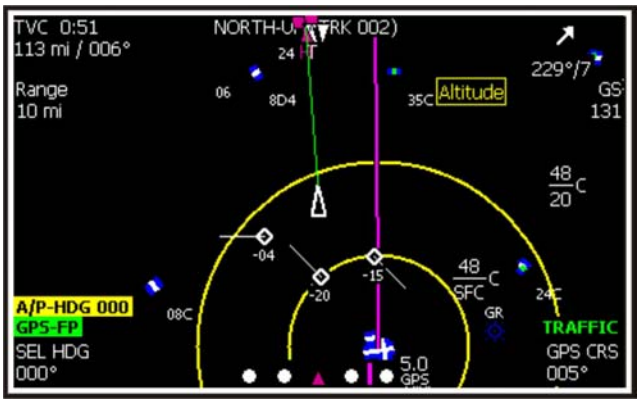


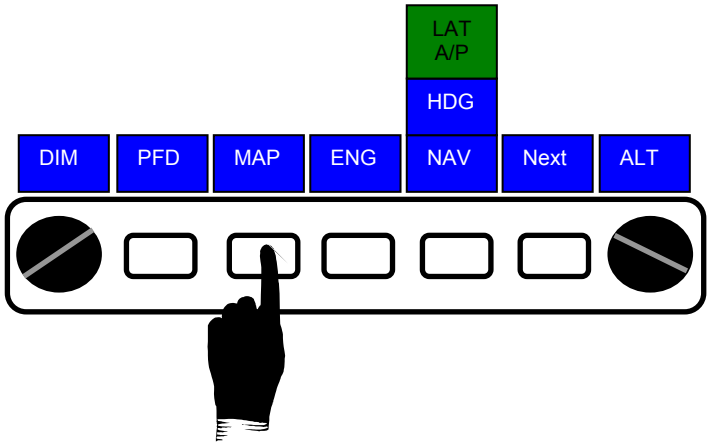
Fig. 2-5 North Up

2.2 Moving Map Group (GPS option req'd)

The GRT Sport moving **MAP** group consists of the following pages: North-up, Arc, 360^0 and HSI. These pages display the following:

- Navaids
- GPS waypoint/route data
- XM Weather (optional)
- Traffic (optional-GX330 transponder required)
- Course deviation

Pages within the **MAP** group are selectable by using the **MAP** labeled button. Pressing the button cycles the Arc, 360^0 and North-up pages. An additional HSI page is available when a Garmin SL30 is connected.



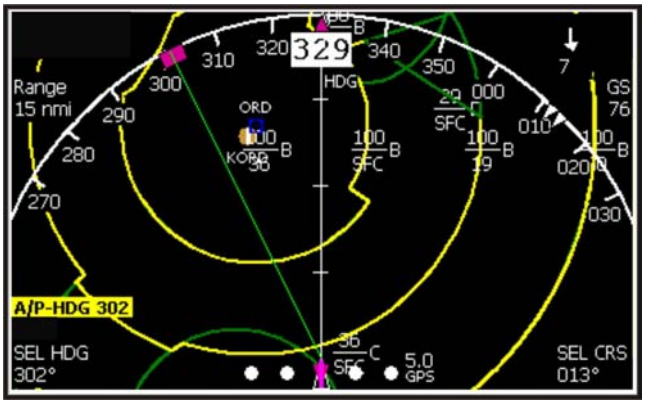


Fig. 2-6 Arc

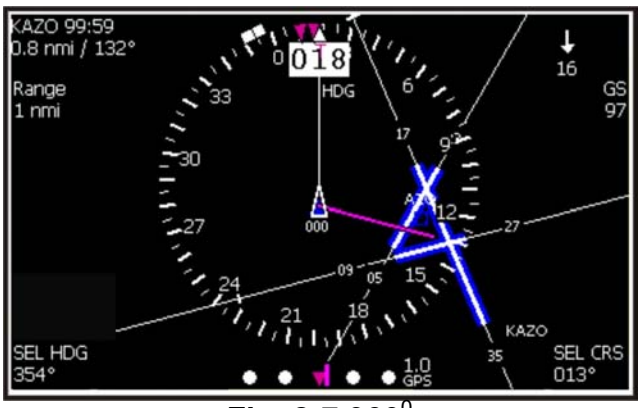
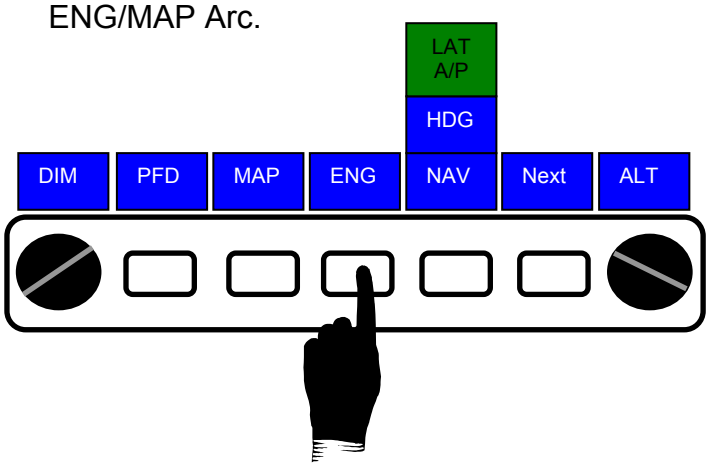


Fig. 2-7 360^0

Fig. 2-8 HSI

2.3 Engine Group (EIS option req'd)

Within the **ENG** group are selectable pages. By using the **ENG** labeled button you may select the ENG page or split page ENG/MAP Arc.



The GRT Sport **ENG** page displays engine parameters in a variety of user selectable graphics including the following:

- Revolutions per Minute (RPM)
- Manifold Pressure (MAP)
- Oil Temperature/ Pressure
- Voltage
- Cylinder Head Temperature
- Exhaust Gas Temperature
- Fuel Flow/Pressure
- Coolant Temperature
- Carburetor Temperature
- Turbine Inlet Temperature
- N1/N2
- Lean Function

Pages within the **ENG** page are selectable by using the **ENG** button. Pressing the button shows the engine or engine /MAP arc view.

Fig. 2-9 Engine

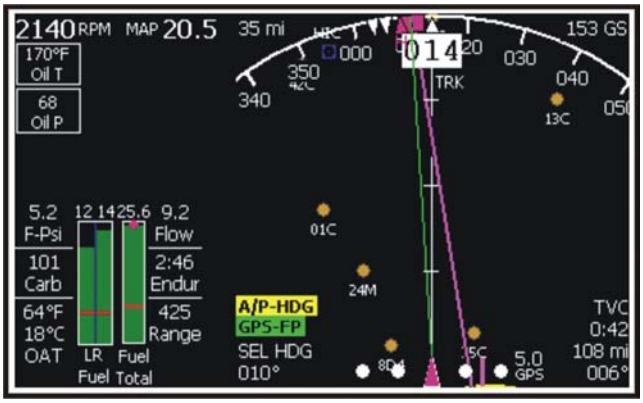


Fig. 2-10 Engine/ Map Arc

2.4 Flight Data Recording

The GRT Sport allows you to record flights and engine data using the **DEMO** feature.

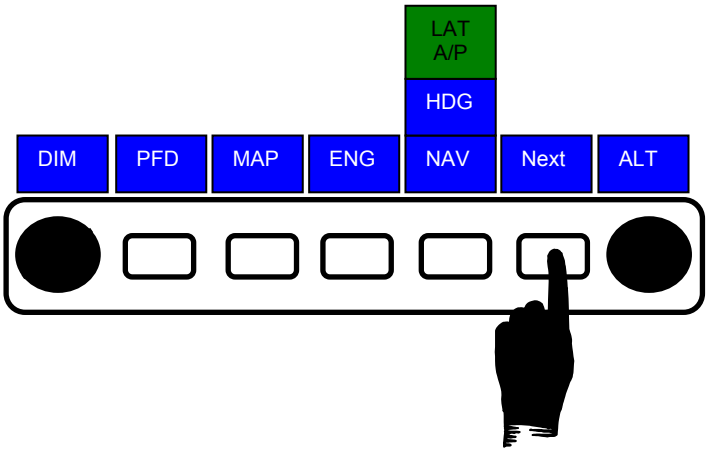
This feature will record flight and engine data which can be played back on the display unit. The engine data can be converted and downloaded to a spreadsheet

format for analysis using the **EIS Log** software.

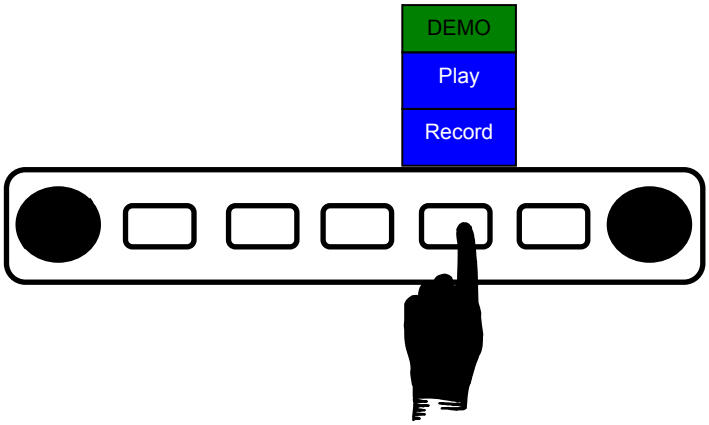
The USB memory stick must be in a MFD to record flight data.

To record a flight using DEMO feature:

1. Press any button then **NEXT** (more than once may be required)



2. Press **DEMO** button to select **RECORD.** (The recording will begin and a message will remind you to stop the recording before turning off the power to the display unit.)



3. To stop the recording locate the **DEMO** button and press **STOP.**

SECTION 3: SYSTEM SETUP

Now that you have your GRT Sport unpacked we will cover the Settings Menu.

Certain features are only available when connected to other equipment. For example, moving map details will only be available if the antenna is connected and a GPS signal is valid.

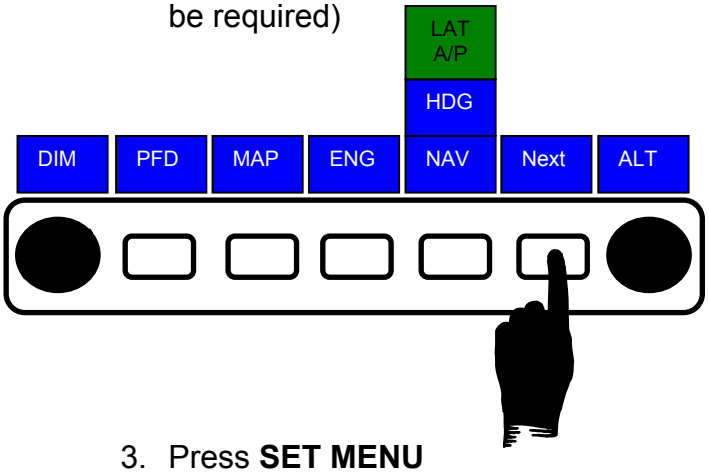
After this your system will be able to communicate with each piece of equipment attached to it. Let's get started!

3.1 General Setup

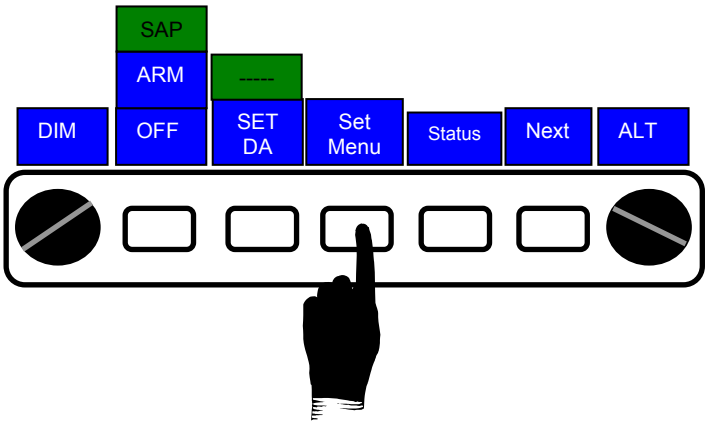
The General Setup allows the setting of equipment inputs and outputs and units of measure. The

To find the Settings Menu:

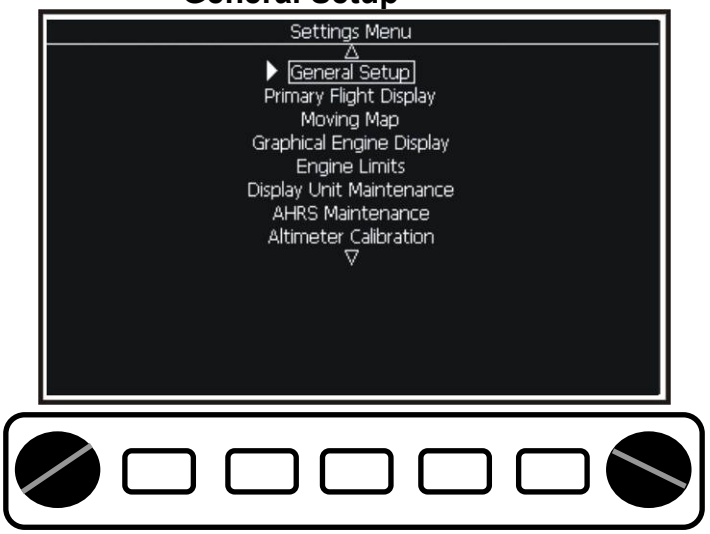
1. Press any button or knob
2. Press **NEXT** (more than once may be required)



3. Press **SET MENU**



4. Use either knob to scroll to **General Setup**



5. Press knob to select

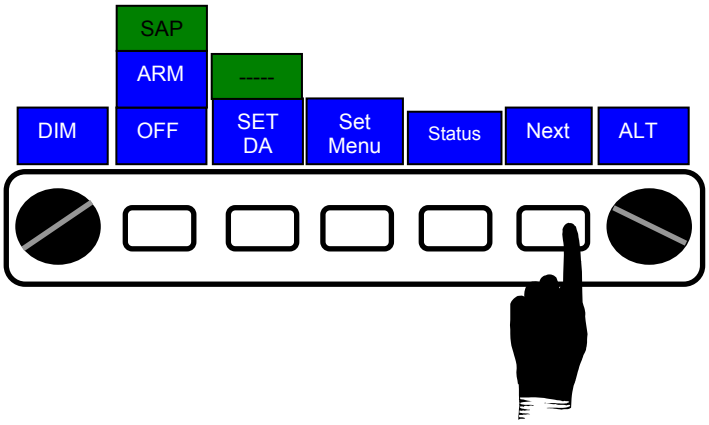
Inter-Display Link

This selection allows access to the **Inter-Display Link** setup menu. This menu allows the GRT Sport to be configured so data may be shared between display units.

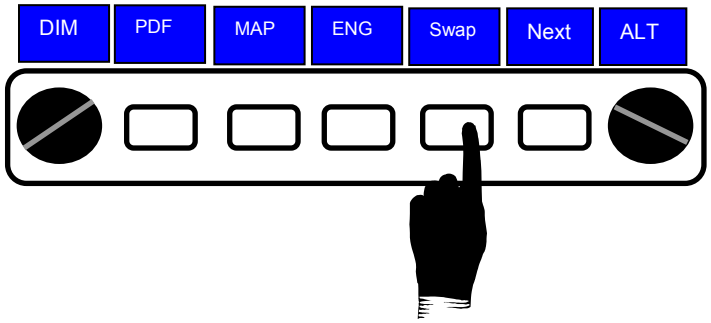
The **SWAP** feature is available in the Dual GRT Sport Package. This allows the information to be swapped from one display to other since one display unit is an S200 Primary Flight Display and the other is the S100 Engine and Map. Once the inter-Display link is configured you may **SWAP** the information by pressing the **SWAP** button.

To SWAP display information:

1. Press any button or knob



2. Press **Next** (more than once may be required)



3. Press **Swap**

To access the Inter-Display Link:

1. Press either knob. When the knob label is highlighted white the field is selected and may be changed.

Note: Not all fields are user selectable. If field is not user selectable the value will not change.

2. Press knob to select.
3. Turn knob to access link page

To change a value:

1. Press either knob.
2. Turn knob to change value
3. Press knob to set

The Table 3-1 lists the input and output description for each setting.

Setting	Selections	Description
Inter-Display Link ID	Auto/Primary/ 2/3/4…	Set one display unit to "Primary", all others to "AUTO". The numeric entries force the display unit to a particular "address", and may be useful for troubleshooting, but should otherwise not be used.
Valid Frames Received	None	Will be continuously changing when the inter-display unit link is operating correctly. (Not a user setting.)
Compare Limits	Yes/No	"Yes" allows the display units to compare limits, and prompt you to correct mis-matching limits between display units. Normally limits are automatically transmitted between display units when updated by the pilot.
Send Analog Inputs	Yes/No	Select "Yes" only if a display unit has analog inputs wire to it that other display units do not have.
Send SL30-1 Commands	Yes/No	Select "Yes" if an SL30 is used as nav/com radio 1, and a different display unit is providing the serial output to the radio.
Send SL30-2 Commands	Yes/No	Select "Yes" if an SL30 is used as nav/com radio 2, and a different display unit is providing the serial output to the radio.
Send SL40 Commands	Yes/No	Select "Yes" if an SL40 is used as a com radio, and a different display unit is providing the serial output to this radio.
Send GPS Data	Yes/No	Select "No" unless another display unit is not provided with GPS serial data. Normally all display units should be wired to the GPS serial data output.
Send Demo Data	Yes/No	"Yes" is preferred, as it allows all display units to show the demo data being re-played from any other display unit.

Table 3-1 Interlink Display Settings

Serial Port Settings

All serial ports can be configured for any of the functions listed below. The function of the port, and the baud rate, must be set correctly according to the equipment wired to the port. The default settings correspond to the recommended wiring described in the installation and cable description documents. The GRT Sport has four serial ports per display unit. Serial Port 4 is a high speed port and must be used for weather if the GRT Weather module is used.

NOTE: Serial Port 4 is a high speed port and must be used for weather if the GRT Weather module is used.

- **Serial Port Input/Output Functions**
  Off
  AHRS-1
  EIS (Engine Monitor)
  GPS NMEA0183 1 or 2
  GPS Aviation 1 or 2
  SL-30 1 or 2
  SI-40
  Display-Unit Link
  Weather

- **Serial Port Rate**
  110 / 600 / 1200 / 2400 / 4800 / 9600 / 14400 / 19200 / 38400 / 56000 / 57600 / 115200 / 128000 / 25600

NOTE: The device(s) connected must match or be able to work with the baud rate set.

Serial Port Input Counter

This counter increments when any data, valid or invalid, is received. This function is useful for verify an electrical connection to the port is providing data.

To change a value:

1. Press either knob.
2. Turn knob to change value
3. Press knob to set

EIS Model

This setting allows you to choose which EIS Engine monitor you are using. The default is the 4000/6000/9000 series. The following settings pertain to the engine monitor.

- EIS Temperature Units
- EIS Fuel Flow Units
- EIS Baroset Units

To change a value:

1. Press either knob.
2. Turn knob to change value
3. Press knob to set

Altitude Encoder Setting

This setting is for encoders that do not accept fuel/air data from the GRT Sport. The setting is found in the encoder installation manual and should be set accordingly.

Page Change

This setting controls how page views change. **One Click** (press) of a button or knob will change the view. **Two Clicks** will show the labels after one click (press) then another click is required to change the view.

Default Page

This setting sets the default page after the start up screen is acknowledged.

Speed /Distance Units

Knots, Mile per hour, or Kilometers per hour

Temperature Units
Degrees Farenheit or Celsius

Fuel Units
Gallons or Liters

Tachometer Units
Revolutions per minute or Percent RPM

Manifold Pressure
Inches of Hg or 100 mm of Hg

Oil Pressure Units
PSI or Kg/cm2

Outside Air Temperature Source
Auto, AHRS or EIS

SL30 OBS Source
GRT Course Knob or SL30 NAV head

GPS1 Flight Plan Source
Internal or External

GPS2 Flight Plan Source
Internal or External

Virtual GPS2
The setting allows the Sport to use external GPS position data and internal flight plan to make a GPS2 nav mode.

Lateral Autopilot Functions
On or **OFF**, This setting turns on page view labels for **LAT A/P**.

Autopilot Serial Output
Normal or **GPS Coupler** – This setting is for older autopilots that use a GPS coupler. Default setting is **Normal**.

Adjusting GPS Coupler-equipped Autopilot Response

Gain adjustments are provided to allow the user to optimize the commands provided to the autopilot if a GPS Coupler is used.

If a GPS Coupler is not used these settings are not required. The autopilot handles all functions.

NOTE: It is recommended the EFIS Sport autopilot gains be left at the factory settings of 1.0.

To access Gain Adjustments:

1. Press a button
2. Press **NEXT** button (more than once may be required)
3. Press **SET MENU** button
4. Select **General Setup**, press knob
5. Scroll to **Autopilot Serial Output**
6. Highlight by pressing knob (setting will have a white box around it)
7. Change setting to **GPS Coupler**
8. Press knob to **CHANGE**

NOTE: Depending on the intercept angle when the approach is captured, the turn rate available through the autopilot, and other factors, pilot intervention may be required to capture the approach without overshoot.

The recommended procedure for intercepting the synthetic approach is to do so at a distance of 8 nm or more from runway, at an intercept angle of 45 degrees or less.

The accuracy of the autopilot to track the synthetic approach will be maximized when the intercept occurs in this manner.

The adjustment of these gains allows the user to account for variations in the response of the autopilot, airplane and pilot's preferences for the aggressiveness of autopilot tracking.

The following guidelines are provided to assist the pilot with adjustments to these gains.

Start with all gains at 1.0

Cross Track Gain (**XTGain**) - Normally this gain should not be altered, as it currently affects GPS and Synthetic Approach. With the **Roll Gain** adjusted as desired, airplane on course with minimal cross-track error, change to heading mode, select a heading 20 degrees different from the current heading. When the airplane is 500-1000' off course, and heading 20 degrees away from the course, change back to NAV mode for the lateral autopilot mode. Adjust the **XTGain** so that the airplane recaptures the GPS course with a small overshoot. If **XTGain** is too low, the intercept angle will be at shallow angles, and will be sluggish. If too high, overshoot will be observed.

Roll Gain - Put the airplane on the course; with zero cross-track error (use the GPS on a 500' range scale to see when very close to being on track.) Note how much activity there is in the ailerons in smooth air while on course. Set the roll gain as high as possible, but not so high that it results in any noticeable roll activity in smooth air. Note that Roll Gain affects all modes except Heading.

Heading Gain - Slow the airplane to the minimum speed at which you will use the heading select function. Adjust the Heading gain as high as possible without excessive roll or heading oscillations.

3.2 Primary Flight Display Settings

To set PFD settings from the PFD page:

1. Press a button
2. Press **NEXT** button (more than once may be required)
3. Press **SET MENU** button
4. Scroll to **Primary Flight Display**
5. Press knob to select

Up Reference

This setting allows for Heading or GPS track to be display in the heading field.

Stall Speed (Vs)

Stall speed is the lower end of the airspeed tape at the bottom of the green and white sections. This speed setting results in airspeed below is red on the airspeed tape.

Max Flap Extension Speed (Vfe)

This setting is the top of the white section on the airspeed tape.

Max Structural Cruising speed (Vno)

This setting is the top of the green section of the airspeed tape.

Max Speed (Vne)

Never Exceed speed. This setting is the bottom of the red section of the airspeed tape.

Speed Bug 1-3

These are user selectable speed bugs.

Below stall

Red or none. This allows user selectable colors for speeds below stall speed.

HITS (Highway – In – The – Sky) frame color

Colors the HITS boxes and is user selectable.

Attitude Heading Reference Index
Allows for BARS or NOSE to be displayed. The BAR settings shows “wings”, the NOSE setting is a circle with a line through it.

GPS CDI
Turns on the GPS CDI in the PFD page.

Slip Indicator
Turns on the slip indicator.

Turn Rate Indicator
Turns on the turn rate indicator

Wind Indicator
Turns on the wind indicator and displays, **Vector/ Speed** and **Direction**

Digital Head/Cross Wind Display
Turns on the head or crosswind indication

Baroset Units
Inches of Hg or millibars

Artificial Runways
On or Off

Flight Path Marker
On or Off. The Flight Path Marker is the projected flight path the aircraft will take with current conditions.

Airspeed Display Size
Normal or Large

Altimeter Display Size
Normal or Large

Track/ Heading Display size
Normal or Large

Airspeed Resolution
Fine or Coarse

Max Indicator vertical speed
This is the maximum setting for the Vertical Speed indicator

Pitch Ladder Offset
-15 to + 15 degrees

Flight Level Altitude
This setting automatically sets the baroset to standard pressure when at or above this preset altitude

Altitude Alerting
On or Off

Max Altitude Deviation
Altitude deviation which will trigger the above mentioned alarm

Climb IAS Preset 1 & 2

Climb VS Preset 1 & 2

Descent IAS Preset 1 & 2

Upper Left Corner Box
Ground Speed or True Airspeed

Data Boxes
On or Off, This setting turns on the data boxes at the bottom of the PFD page.

Labels and data for these boxes are as follows:

OFF
DATA: Dest Waypoint ID
DATA: Dest Wpt Est Time Enroute
DATA: Dest Waypoint Range
DATA: Dest Waypoint Bearing

DATA: RPM
DATA: RPM2
DATA: N1
DATA: N2
DATA: Oil Temperature
DATA: Oil Pressure
DATA: Coolant Temperature
DATA: Carb Temperature
DATA: Highest EGT (Exhaust Gas Temperature)
DATA: Highest CHT (Cylinder Head Temperature)
DATA: Highest TIT (Turbine Inlet Temperature)
DATA: MAP (Manifold Pressure)
DATA: Fuel Pressure
DATA: AMP (Amps)
DATA: Outside Air Temperature
DATA: Density Altitude
DATA: Volts (from EIS)
DATA: Fuel Flow
DATA: Fuel Remaining (from Fuel Flow)
DATA: Fuel Range (from Fuel Flow)
DATA: Groundspeed
DATA: True Airspeed
DATA: Percent Power
DATA: Power Bus 1Voltage
DATA: Power Bus 2 Voltage
DATA: Power Bus 3 Voltage
Label: ETE (Estimated Time Enroute)
Label: RNG (Range)
Label: BEAR (Bearing)
Label: DEST (Destination)
Label: RPM (Revolutions per minute)
Label: RPM2 (Revolutions per minute)
Label: N1
Label: N2
Label: OilT (Oil Temperature)
Label: OilP (Oil Pressure)
Label: Cool (Coolant Temperature)
Label: Carb (Carburetor Temperature
Label: Hi EGT
Label: Hi CHT
Label: Hi TIT
Label: MAP (Manifold Pressure)
Label: FPrs (Fuel Pressure)
Label: L Fuel (Left Fuel tank)
Label: R Fuel (Right Fuel tank)
Label: AMP (Amps)
Label: Volts
Label: Volt1
Label: Volt2
Label: Volt3
Label: D Alt
Label: OAT (Outside Air Temperature)
Label: GS (Groundspeed)
Label: TAS (True Airspeed)
Label: Power

Approach Glideslope Angle
2 – 8 degrees

Approach Height Intercept
(NOT USED-reserved)

ILS Type
Off, Needles or Scales. This setting displays scales or traditional needles for ILS course deviation.

Show VOR CDI on Localizer
Yes or No. This setting shows the VOR CDI when localizer is active.

Show GPS CDI on LOC/GS
Yes or No. This setting displays the GPS CDI when localizer and glideslope is active.

ILS Inhibit of HITS
Inhibit HITS or No inhibit of HITS. This setting will enable/disable the Highway-In-The-Sky when the ILS is active.

Default Decision Height
Typically, 200 ft.

G-Meter Mode
Off, Auto, On, On with Min/Max. The auto setting displays the G-meter when a preset limit has been passed.

G-Meter Caution
This setting displays a warning when this limit is passed.

3.3 Moving Map Settings

To set Moving Map settings from the PFD page:

1. Press any button
2. Press **NEXT** button (more than once may be required)
3. Press **SET MENU** button
4. Scroll to **Moving Map**
5. Press knob to select

Up Reference
This setting allows for Heading or GPS track to be display in the heading window.

Airport Symbol Size
Large or Small

Label Font Size
Large or Small

HSI Plane Symbol
Conventional or Canard

Connect Bearing Pointers
Yes or No

Max map range: Small airports
This is a de-clutter setting. It will show small airports up to the set range.

Max map range: Medium airports
This is a de-clutter setting. It will show medium airports up to the set range.

Max map range: Large airports
This is a de-clutter setting. It will show large airports up to the set range.

Max map range: VOR
This is a de-clutter setting. It will show VORs up to the set range.

Max map range: NDB
This is a de-clutter setting. It will show NDBs up to the set range.

Max map range: Airspaces
This is a de-clutter setting. It will show airspaces up to the set range.

Max obstructions distance:
This is a de-clutter setting. It will show obstructions up to the set range.

Obstacle Alarm
On or Off

Terrain
On or Off

Terrain Alarm
On or Off

Auto Declutter
This setting turns on the preset declutter settings.

Show Lighting
This setting displays lighting on user selected map pages.

Show AIRMET

This setting displays AIRMETs on user selected map pages.

Show METAR

This setting displays METARs on user selected map pages.

3.4 Graphical Engine Display Settings

To set Graphical Engine Display settings:

1. Press any button
2. Press **NEXT** button (more than once may be required)
3. Press **SET MENU** button
4. Scroll to **Graphical Engine Display**
5. Press knob to select

3.5 Engine Limits

See table below for recommended settings.

Setting	Use	Recommended Setting
Max Time	Alerts pilot when flight time exceeds this limit. Useful as a warning to check fuel. Limit is entered in minutes, so 2 hours is entered as 120, etc. Range is 0-500 minutes.	30-45 minutes less than airplane's endurance.
Interval	Provides a warning that repeats at the interval entered in minutes. Useful as a reminder to perform periodic tasks such as switching fuel tanks. Acknowledging this alarm cancels the warning completely, therefore the warning light will not remain on after acknowledging this alarm. Range is 0-500 minutes.	As required. Typically 30-60 minutes is used for changing fuel tank selection.

Max Flow	Maximum Fuel Flow – Generates a warning when the fuel flow (rate of fuel burn) exceeds this limit. Useful for detecting badly leaking fuel lines, loose connections to fuel injectors, etc. Very useful safety feature for all engines, but especially fuel injected engines. Be sure to use it! Range of Max Fuel Flow Limit is 0-500 gph, in increments of 1 gallon/hour.	Set about 10-20% above max fuel flow rate at full takeoff power. Applicable only if the fuel flow option is installed.
Max OilP	Maximum Oil Pressure. Useful as a reminder to reduce RPM when warming a cold engine, especially in winter conditions, to avoid excessive oil pressure. Range is 0-99 psi	98 or less. Max oil pressure displayed by the instrument is 99 psi.
Min OilP	Minimum Oil Pressure – Essential! Be sure to use this one! Warns of loss of oil pressure. As this is the most serious alarm, some pilots may take drastic action when seeing this alarm. Consider you situation carefully if you get this alarm. An instrumentation failure (sensor failure) is possible, as is complete engine stoppage or anything in between. Use your judgment! Range is 0-99 psi	As recommended by the engine manufacturer, or 20 psi.
Min Crz_OP	Minimum Cruise Oil Pressure - Generates a warning when the oil pressure is below this limit. This limit is active only when the engine RPM is above the min Lim-RPM setting. This allows setting a low oil pressure limit that apply only at higher engine. RPM.	As recommended by engine manufacturer, if available. If not provided, set based on experience.
Max OilT	Maximum Oil Temperature Range 0-300 deg F.	As recommended by engine manufacturer.
Min OilT	Minimum Oil Temperature – Intended for troubleshooting engine problems. Also useful as an “engine not warmed up yet” reminder. Range is 0-300 F.	Set limit based on experience.
Max RPM	Warns when engine exceeds maximum RPM. Range of Max RPM Limit is 0-9990.	Set according to engine manufacturer’s recommendation.
Min RPM	Warns when engine RPM falls below this entry. Useful for troubleshooting engine problems. May also be used as a warning that the engine RPM is dropping too low on the landing rollout which could result in engine stall. No warning is generated when the engine RPM is zero. Range is 0-9990.	Set limit based on experience.

Min Fuel	Minimum Fuel Quantity – Generates a warning when the fuel flow function's fuel quantity drops below this limit. Range is 0-500 gallons.	Set to at least enough useable fuel to provide 30-60 minutes of fuel at cruise power. Applicable only if the fuel flow option is installed.
Min Aux (1-6) Max Aux (1-6)	Minimum & Maximum for Aux input. (ideally these limits would use the name the user selected for this input. The displayed value must be either an integer or a decimal number with 1 digit after the decimal, according to the user selections below.) Range is 0-999, or 0-99.9	Set limit as needed depending on the use of the auxiliary input. Some uses of the auxiliary inputs do not require limits (such as manifold pressure) and some do, such as fuel pressure.
Max H2O	Maximum water temperature limit Range is 0-300 deg F.	Set limit as recommended by engine manufacturer
Min H2O	Minimum water temperature limit. Intended for troubleshooting engine problems. Also useful as an "engine not warmed up yet" reminder. Range is 0-300 deg F.	Set limit based on experience.
Max Volt	Maximum Voltage Limit – Allows for detection of failed regulator. Loss of correct voltage regulation resulting in over-charging (and subsequent high voltage) will greatly shorten the life of the battery, and could be dangerous. Range is 0-35.0 volts (increments of 0.1 volts)	Start with 15.6 volts. Lower as much as possible without getting false alarms. Typical limit should be 14.6 Volts.
Min Volt	Minimum Voltage Limit – Allows for detection of loss of charging. Range is 0-35.0 volts (increments of 0.1 volts)	Set limit to about 12.8 volts to get immediate alerting of loss of charging, although this will cause low voltage alarm whenever instrument is on while engine is not running. Set to 12.4 volts or less to avoid alarm when engine not running, but still gives alarm shortly after battery discharging has begun.
Max Carb	Carb temp warning is generated when the carb temp falls between the Max Carb and Min Carb Limit. Range is –30 to +120 deg F	40-60 deg F
Min Carb	See Max Carb Range is –30 to +120 deg F	0-20 deg F
Max EGT	Maximum EGT – Not all engines have published limits, nor do all engines require a maximum EGT limit. This alarm can be useful for troubleshooting engine problems also. Range is 0-1900 deg F	Set limit according to engine manufacturer recommendation, or based on experience.

Min EGT	Minimum EGT – This alarm is active only when the engine RPM is above the entry for EGT-RPM. This alarm is useful to detecting the loss of a cylinder, or for troubleshooting engine problems. Range is 0-1900 deg F	800-1200 deg F, depending on sensitivity desired. If false alarms are consistently generated, reduce the limit to less than 800 deg F, or set to 0.
Lim-RPM	Defines the RPM at which the following RPM dependant limits become active. These are: Min EGT and Min Crz_OP Range is 0-9990 RPM.	Set limit to an RPM slightly less than the RPM used for the MAG check. This allows the Min Volt test to become active during the MAG test to automatically test for charging.
Max EgtSpan	Maximum difference between the highest and lowest EGT. This limit can be used to help detect changes in normal engine operation. It is also useful when leaning using the digital leaning pages, as it is possible to not notice a EGT that is abnormally low when using these pages to lean the engine. (Its more obvious on the bar graph pages.) Range is 0-1900 deg F.	Set this limit based on experience. It may take some trial and error to arrive at a good limit. After establishing a limit that rarely generates alarms, activation of this alarm may indicate developing engine problem.
Max EGT-Inc	Maximum Increase in EGT from the Lean Point. This alarm is active while lean point is active. This alarm will often generate a false alarm when the load on the engine significantly reduced during descent. To avoid this false alarm, reset the Lean Point. (Selecting “Set Lean Page” and “Yes” activates alarm; “Reset” de-activates alarm.) This limit also sets the Sport red line on the vertical bar graph. Range is 0-1900 deg F.	Set limit based on experience. A small value will allow sensitive detection of EGT increases, which is useful for detection of intermittent problems. Normal operation may require a larger setting to prevent false alarms due to normal EGT fluctuation caused by turbulence or other small power/load fluctuations.
Max EGT-Dec	Maximum Decrease in EGT from the Lean Point. See also Max EGT-Inc description. Range is 0-1900 deg F.	Set limit based on experience. You may find that this limit is significantly different from the Max EGT-Inc. See also Max EGT-Inc description.
Max Crate	Maximum Cooling Rate for CHT – The alarm is provided in degrees/minute, and corresponds to the maximum rate of decrease in CHT. No limit applies to the maximum rate of increase. All cylinders are checked for this limit. Range is 0-255 deg F/minute.	Set limit based on engine manufacturer’s recommendation. If no limit is provided, establish a limit based on experience.

Max CHT	Maximum Cylinder Head Temperature. Often engines will normally operate significantly lower than the engine manufacturer's limit. Consider setting this limit lower than the maximum to get early warning of abnormal CHTs. This limit also sets the Sporttal red line on the vertical bar graph. Range is 0-700 deg F	Set according to engine manufacturer's recommendation.
Min CHT	Minimum Cylinder Head Temperature. Intended for engine troubleshooting problems. Also useful as an "engine not warmed up yet" reminder. Range is 0-700 deg F	Set limit based on experience.

3.6 Display Unit Maintenance

This page allows system maintenance and installing/recording data within the GRT Sport.

EFIS Settings Backup

This feature allows you to backup and restore all settings to a USB flash drive. The Backup Directory function will name a directory on the flash drive for easy identification. The Backup All Settings will backup the settings for the display unit you are saving from.

To restore the settings previously saved, select the directory you want. For example BACK0001.

Load EFIS Software

This feature allows you to load new GRT software. The USB flash drive (memory stick) must be installed in the display unit and the unit powered. In multiple display systems each unit must be loaded with the software and the software version must match on each display unit.

To Load EFIS Software:

1. Press any button
2. Press **NEXT** knob (more than once may be required)
3. Press **SET MENU** knob
4. Scroll to **Display Unit Maintenance,** press knob
5. Scroll to **Load EFIS Software,** press knob and turn to start

Copy Terrain

This feature allows you to load terrain data, again from the USB flash drive (memory stick).

To copy terrain data:

1. Press any knob
2. Press **NEXT** knob (more than once may be required)
3. Press **SET MENU** knob
4. Scroll to **Display Unit Maintenance,** press knob
5. Scroll to **Copy Terrain Data,** press knob and turn to start

To view the terrain data on the MAP page make sure **TERRIAN** is selected with the **SHOW** knob.

Weather Status

To activate the weather module you must have XM Weather service established and the Sport set to receive incoming signals.

To activate the weather module (assuming activation has been requested from XM) :

1. Press any button
2. Press **NEXT** knob (more than once may be required)
3. Press **SET MENU** knob
4. Scroll to **Display Unit Maintenance,** press knob
5. Scroll to **Weather Status**, change to activate menu
6. Scroll to **Activation Mode**, turn to **ON** within 4 hours of XM subscription activation

If the activation is successful the **Service Level** will show the subscribed level and the **Signal Status** should be at least **Marginal** or better for good reception.

7. Turn **Activation Mode** to **OFF**. If left **ON** weather data will not show on **MAP** pages.

The other functions on this page are for troubleshooting by GRT technicians and should be changed with care.

To find the unit serial number select the **PIC Calibration Data** to find **Serial Number**.

3.7 AHRS Maintenance

This page displays raw data measurements useful for calibration and troubleshooting. See Section 3: Calibration for more detail.

Maintenance / Built-In-Test Messages

All devices connected via the serial ports can generate either of the following messages.

Device – No Communication. This indicates a serial port has been assigned to receive data from this device, but no serial data is being provided by this device. This could occur if the device is not turned on, or its serial data output is not connected, or if it has suffered a failure

Device – Checksum Failure. Data from the device was received in the last 10 seconds which failed its checksum test. This indicates communication with this device may be unreliable.

Status

At anytime the status to the GRT system is available by pressing the **STATUS** button.

True Airspeed Corrections

This setting allows for corrections to up to 8 true airspeeds. See Section 3: Calibration for more detail.

SECTION 4: FLIGHT DISPLAY

Welcome to the GRT Sport! In this section we will show you the symbology and function within each group starting with the Primary Flight Display. At first glance it looks like a lot of information, you're right, but in a short amount of time you will be able to use every feature with ease.

4.1 Using the Primary Flight Display

Below is the basic PFD page.

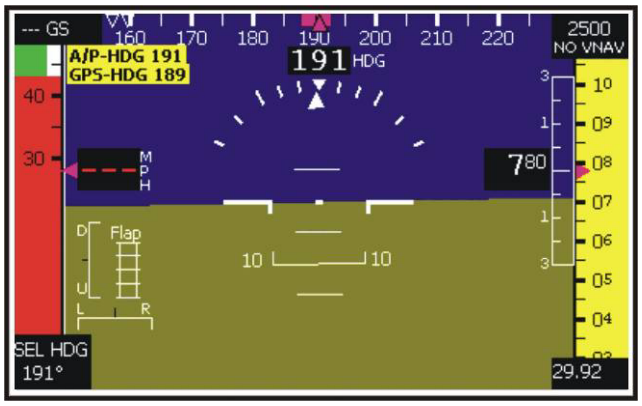


Fig. 4-1 PFD Screen

The basic PFD page consists of the basic instruments:

- Artificial Horizon
- Altimeter Tape with Digital Display
- Airspeed Tape with Digital Display
- Heading Tape with Digital Display
- Vertical Speed Indicator

These are arranged with the Artificial Horizon in the center, the Airspeed Tape on the left, the Altimeter Tape on the right, the Heading Indicator along the top and the Vertical Speed Indicator next to the Altimeter.

You will also notice the Pitch Ladder, Bank Angle Indicators in the center of the screen, and the Trim/Flap Indicator in the lower left (under the Airspeed Digital Display).

To finish the basic PFD page there are five boxes which display:

- Ground or True Airspeed-upper left
- NAV Mode Status – below GS
- Heading Select – lower left
- Altitude Select/Status - upper right
- Altimeter/Baroset Setting – lower right

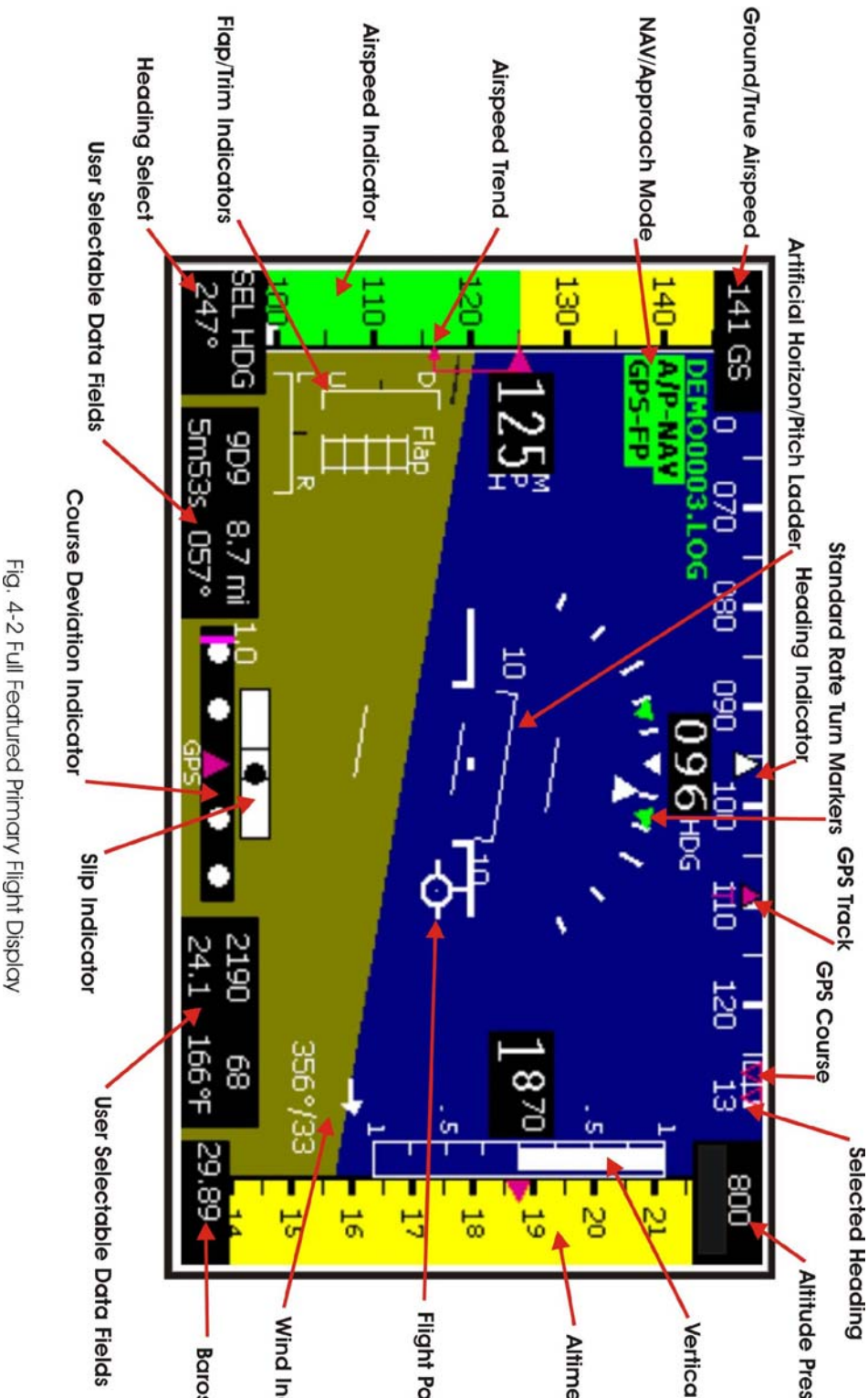


Fig. 4-2 Full Featured Primary Flight Display

4.2 Artificial Horizon

The Artificial Horizon is just that, a pictorial representation of the earth's Sport. The blue portion represents the sky; the brown portion represents the ground.

A portion of the artificial horizon is the Pitch Ladder. It depicts pitch angle of the aircraft in relation to the horizon.

The Flight Path Marker, shown as a circle with three spikes depicts the aircraft's flight path. The FPM will appear to float about the display as the aircraft pitches and rolls. This movement is most evident in strong crosswind or unusual attitudes.

4.3 Airspeed and Altimeter

The Airspeed tape shows airspeed and set points for stall (Vs), flap extension (Vfe), maximum structural cruising speed, (Vno), never exceed speed (Vne), and three user selectable speed bugs. These are set in the **SET Menu, General Setup, Primary Flight Display.**

The Altimeter Tape shows mean sea level (MSL) altitude in hundreds of feet. It also shows the Off Route Obstacle Clearance Altitude (OROCA) which provides obstruction clearance with a 1,000 foot buffer in non-mountainous terrain areas and a 2,000 foot buffer in designated mountainous areas within the United States. An altitude below the OROCA is shown yellow, above the OROCA is shown green.

In between the airspeed tape and window is the trend indicator. This is a red arrow that indicates the direction and rate of airspeed increase or decrease. And points to the airspeed the aircraft will be at in 5 seconds.

To set the Altimeter/barosetting:
Turn the right knob on any **PFD** page, press to enter.

To set an Altitude Preset bug:

1. Press the right knob on any **PFD** page.
2. Turn knob to desired Altitude
3. Press knob to set.

4.4 Heading

The Heading Tape is able to show heading or GPS track.

GPS ground track is displayed as a triangle with a "T" written below it. Its position relative to the heading scale indicates the current ground track.

Also on the Heading Tape is a pair of inverted triangles indicating the bearing to the GPS waypoint. Aligning the ground track indicator with this indicator will result in a ground track directly to the waypoint.

The indicators will be either white or magenta. The magenta colored triangles signify the a/p nav mode being used, **HDG** or **NAV**.

When a strong cross-wind component results in a ground track that differs from heading (drift angle) by more than 30 degrees, the ground track triangle becomes hollow to indicate it is "display-limited". Simultaneously, the waypoint bearing indicator also becomes hollow. The relative position between these two indicators remains accurate, allowing the pilot to align these two indicators to achieve a ground track directly to the GPS waypoint in the same manner as if they were not display limited.

When the ground track indicator is display-limited, the flight path marker and ground-referenced symbols (runways and

obstacles) are artificially shifted so that they remain on the screen, but in such a way that their position relative to each other is correct. This allows these items to be visible on the screen no matter how large the drift angle.

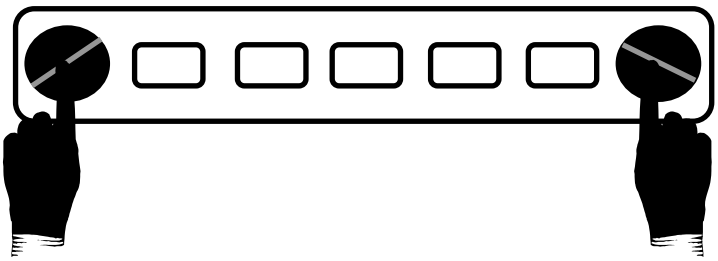
CAUTION: When the ground track indicator is hollow, indicating it is display-limited; the ground track indicated is necessarily inaccurate. This means that the aircraft's track over the ground is not as indicated, and the pilot should be aware of this inaccuracy with regard to obstacle and terrain clearance.

If the waypoint bearing indicator is off the scale, an arrow will appear in the upper left or upper right portion of the screen indicating the direction to turn to achieve a ground track to the waypoint.

The digital representation of the heading is shown below the Heading Tape and is user selectable to **HDG** or **TRK**.

To select a heading:
Turn the left knob on a **PFD** or **MAP** page to the desired heading.

To select the current heading:
Press both knobs simultaneously.



4.5 Wind Speed/Direction and Turn Coordinator

The wind speed and direction is displayed in a variety of formats as described in the **Primary Flight Display** settings section of this manual. The vector representation of wind direction (the arrow drawn on the screen) shows wind direction relative to the aircraft's heading. A wind vector pointing directly up indicates a tailwind and a vector pointing to the right indicates the wind is blowing from left to right.

The numeric display of wind direction is relative to magnetic north.

If insufficient data exists for calculation of winds, the wind vector arrow, and digital data, is blanked (not displayed). Calculated winds are based on GPS ground track and groundspeed, and heading and airspeed data provided by the AHRS. Accurate winds require accurate magnetic heading and airspeed data.

In addition to direction and speed Head/Crosswind components may be displayed as well.

The Turn Coordinator is depicted at the top of the pitch ladder and below the heading window as inverted green triangles. The GRT Sport adjusts the angle of bank required to make a Standard Rate turn at a given airspeed. The Turn Coordinator triangles will spread out or in as the airspeed increases or decreases.

GPS CDI Display & Slip Indicator

The GPS CDI is located at the bottom center of the screen. It displays the direction and magnitude of the GPS cross-track error. The cross-track error is the distance from the aircraft's current position, to the line connecting the previous and next waypoint in the GPS flight plan. (When only one waypoint is active in the flight plan, most GPS navigation equipment will use the aircraft's position at the time the waypoint is

selected as the previous waypoint position for purposes of calculating cross-track error.)

The cross-track deviation is represented by the deflection of the bar from the center of the CDI scale. A deflection to the left indicates the airplane needs to be maneuvered to the left to get back on course. The center of the CDI includes a triangle that points up or down to indicate **TO** or **FROM** the GPS waypoint respectively. Note: **FROM** indications result in reverse sensing for the deviation indicator, identical to that of a VOR type CDI indicator. This allows normal sensing when tracking outbound from a GPS waypoint.

The deviation bar and TO/FROM indicator are be displayed whenever a **GOTO** waypoint is active in the GPS flight plan.

The scaling of the CDI indicator changes automatically from 5.0 nm full scale when enroute, to 1.0 nm full scale in terminal phase (within 30 nm of the destination), to 0.3 nm during approach phase. Approach phase is determined can be detected by the GRT only when **Aviation** format of GPS data is provided to the GRT

For additional Primary Flight Display page views press **PFD** for a combination of Primary Flight Display, Moving Map and Engine pages.

The slip indicator works just like a water level slip indicator.

4.6 User Selectable Data Boxes

There are 8 places for user selectable data to placed, anything from GPS waypoints to engine parameters may be placed in these boxes.

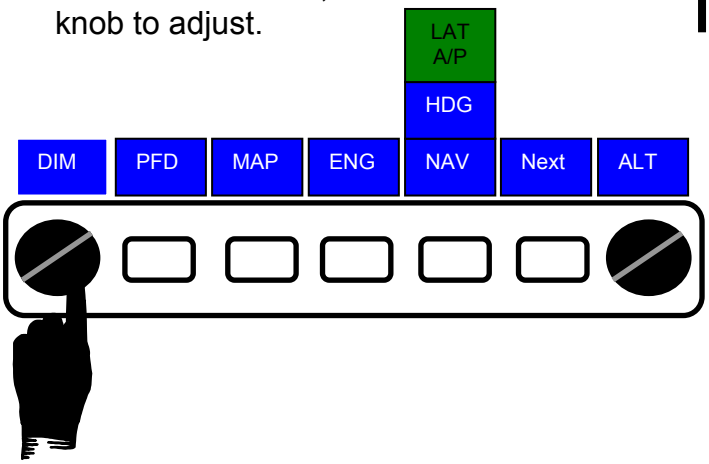
To turn on user definable settings:

1. Press any button followed by **NEXT** until you find **SET MENU.**
2. Press **SET MENU** followed by
3. Scroll to **Primary Flight Display**.
4. Press knob to select.

4.7 Fixed Data Boxes

There are 4 data boxes that display ground speed or true airspeed in the upper left corner, heading selection in the lower left corner, autopilot altitude selection and status in the upper right and the baroset in the lower right.

To adjust the screen brightness:
Press the left knob, select **DIM**. Turn the knob to adjust.



4.8 NAV Mode

This setting selects between up to two GPS or NAV sources. The user is able to use GPS radios and label the NAV MODE as such, for example, GPS 1 and GPS 2.

To select a NAV mode:
Press **PFD** and select **GPS or NAV**

To turn on user definable settings:

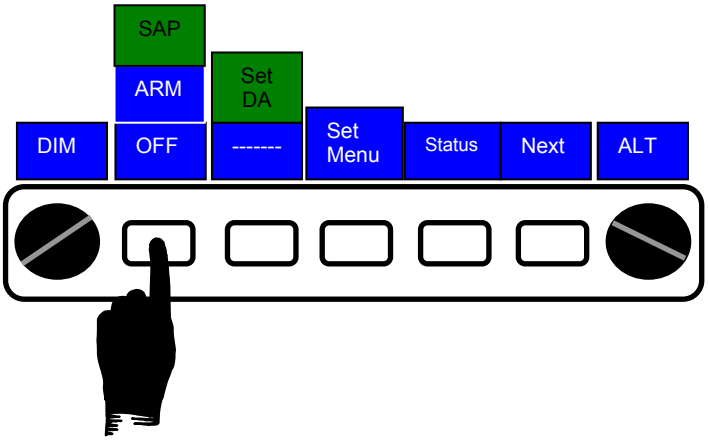
1. Press any button

2. Press **NEXT** (more than once may be required)
3. Press **SET MENU.**
4. croll with either knob to **Primary Flight Display**.
5. Press knob to select.

The **Primary Flight Display** Setting Menu allows to you customize the **PFD** page to your aircraft and liking. For a description of settings see **Section 2: General Setup**.

4.9 Selecting the Synthetic Approach

The approach mode is selected on the primary flight display page, using the **SAP** knob. Select **SAP** to **ARM** the approach mode.



An approach will be provided if all of the following is true:

- The last waypoint in the flight plan is an airport, and is contained within the GRT Sport navigation database, or if an approach has been selected and the GRT Sport is able to determine the airport and runway being used by the approach.

- The database contains the necessary information about this airport, including runways, runway orientation, position, elevation, etc.

- ADC/AHRS and GPS data are valid.

The desired runway is selected turning the left knob.

KGRR 08 8501 HARD PCL 12KTS
KGRR 17 8501 HARD PCL XWind 12KTS L
KGRR 35 8501 HARD PCL XWind 12KTS R
Runway
KGRR 26 8501 HARD PCL 12KTS

The selected runway will blink yellow on the **MAP** page. This list shows the runway identifier, the length, surface (hard or soft), lighting, and crosswind component. The crosswind component is shown as X-Wind = speed L/R, where the speed is in the units selected on the GRT Sport, and the L/R indicates a left or right crosswind, such that a left crosswind indicates the wind is blowing from left to right when on the approach. The GRT Sport will list the runways in order of how closely aligned they are with the calculated wind direction. Runways that are predicted to have a greater than 10 mph tailwind are shown with a yellow background.

After selecting a runway, it may be changed by using the **SAP** knob again. It will

CAUTION: The pilot must not rely on this data for selection of the appropriate runway. Wind speed and direction is usually different on the surface. The GRT Sport is making its prediction based on its calculated winds at the time the approach mode is activated. The accuracy of the wind calculation is affected by the accuracy of the pitot/static measurements, and the calibration of the magnetometer.

provide a **Chg Rwy** selection.

If the selected runway includes an associated localizer in the GRT Sport navigation database, the message **Synthetic Approach using Loc Course** will be provided to remind the pilot that the approach will follow the localizer, and may not necessarily be aligned with the runway centerline.

If the approach mode is selected, but the GPS flight plan does not contain an approach or an airport as the last waypoint that can be matched to the GRT Horizon database, then the synthetic approach cannot be activated. The GRT Horizon will respond with a message **No Airport found for Synthetic App**, and the approach mode will be turned off.

4.10 Flying the ILS

The GRT Sport although a VFR platform allows indication of the ILS in scales or needles format when a ILS frequency is tuned in the SL30.

To turn on needles or scales setting:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU.**
4. Scroll with either knob to **Primary Flight Display**.
5. Press knob to select
6. Scroll to **ILS Type**
7. Press knob to select and change
8. Press **SAVE** button

SECTION 5: MOVING MAP

The Moving Map page(s) provide a top-down view of the world out to the user's selected range and includes the user's defined data from the settings menu.

In this section we will show the **MAP** features, the ability to select airport/navaid data, Auto Tuning the SL30/40, slewing from you present position and changing the range of the **MAP**.

We will also describe the weather, traffic and terrain avoidance features.

5.1 MAP

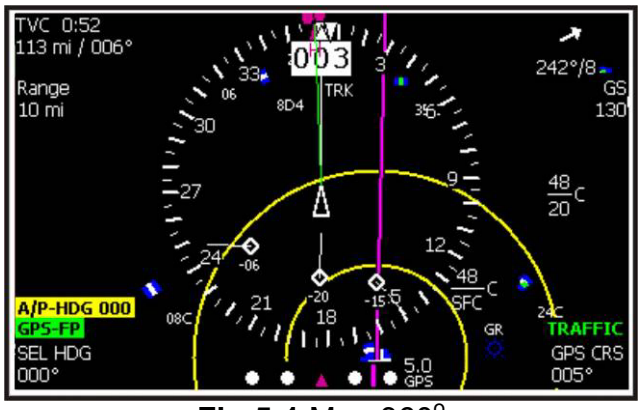


Fig.5-1 Map 360°

The **MAP** group shows:

- Airports
- Airspace
- NAVaids
- GPS/NAV Course
- Heading Select Bug
- HSI (with an SL30)
- NAV mode status
- Wind Direction and Speed
- Weather (optional)
- Traffic (optional)

User-defined databases are limited to waypoints and airports. The airports may include up to 3 runways (6 runway ends).

Approaches to user-defined airports can be selected if the runway end position, elevation, and runway heading are specified.

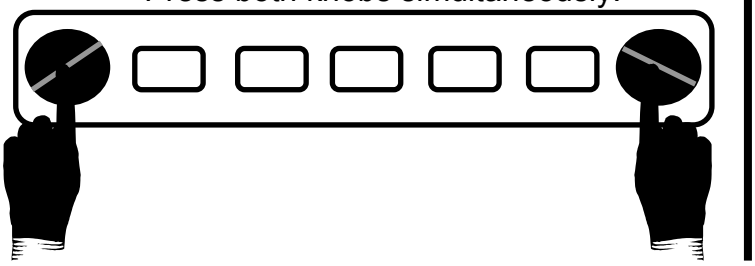
Waypoints, previous and current, are shown connected via a magenta line. Subsequent waypoints are shown connected via a white line.

When a direct-to selection has been made on the GPS, most GPS receivers, including the internal GPS option within the GRT Sport, the GRT Sport will create a "previous" waypoint at plane's position when the direct-to waypoint was selected.

When in heading select mode, a green line is drawn from the airplane symbol to the heading bug.

To select a heading:
Turn the left knob on a **PFD** or **MAP** page to the desired heading.

To select the current heading:
Press both knobs simultaneously.



5.2 Selecting Map Details

When in the **MAP** page information about navaids and airports in the database are selectable by pressing the right knob and turning to the desired airport or navaid.

Fig. 5-2 Waypoint Selection

A yellow line is drawn on the screen from the airplane to the item nearest the map up reference.

This item is highlighted with a yellow circle, and basic information about this item is displayed on the screen. Rotating the knob will move the cursor to the next item nearest according to its bearing.

Details for each navaid or airport, if in the database, are viewable in the Details page. The Details page will also have weather information such as METARs if equipped with the XM Weather module and subscription.

DETAILS
KGRR - Elev 794' GERALD R FORD INTL 0:05
08R-26L 10000 x 150 Hard PCL
08L-26R 5000 x 100 Hard PCL
17-35 8501 x 150 Hard PCL
Fuel 100LL, Jet A
Lat: N42-52.85 Lon: W085-31.37
Mag Var: 5.2W
City: Grand Rapids, MICHIGAN
APP/DEP - 124.6, 128.4
ASOS - N/A
ATIS - 127.1
CLD - 119.3
CTAF - 135.65
GND - 121.8
RDO - LANSING RDO - 115.95, 122.1
TWR - 135.65
UNICOM - 122.95

Fig. 5-3 Map Details

To access the DETAILS function:

1. Press the right knob and
2. Turn the knob to the desired navaid or airport.
3. Press again to select **DETAILS**

5.3 Auto-Tuning (Garmin SL30/40 only)

The GRT Sport's auto tune feature allows you to **SEND LIST**, **SET COM** or **SET NAV** frequencies quickly and easily.

To send a frequency list or set a com or nav:

1. Press any button, followed **MAP**
2. Press the right knob to **SELECT DETAILS**.
3. Use the right knob to scroll through the nearest airport or navaid,
4. Press the knob to select the airport or navaid.
5. Use the sofkeys to **SEND LIST**, **SET COMM** or **SET NAV**

This feature will then program your com or nav with the selected frequency in the standby mode. To use the standby frequency set it to active in the SL30/40.

5.4 MAP Slew

The MAP Slew feature allows you to move the map without changing the map scale.

To slew the MAP view:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SLEW** followed by **WEST**, **EAST**, **NORTH** or **SOUTH**.
4. To return to present position press **EXIT`**

5.5 Range Select

The map view has user selectable range views from 1-1000 miles.

To access the RNG view setting:

1. Press the left knob, the range box will highlight in yellow and show the current range selection.
2. Turn the knob to the desired viewing range.

5.6 XM Weather

XM Weather is an optional feature of the GRT Sport. When equipped the **MAP** page will show precipitation, lighting, meteorological conditions, METARs and AIRMETS according to your XM subscription. (GRT Weather module and XM Weather service required).

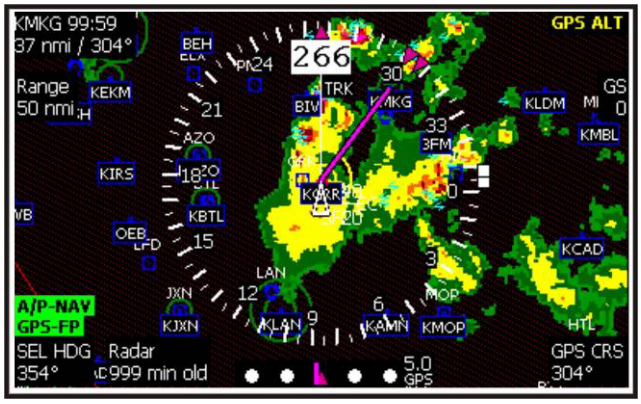


Fig. 5-4
XM Weather - IFR Conditions

5.7 Traffic

The MAP page is capable of displaying traffic if a Garmin GTX330 Transponder is connected to the GRT Sport. Traffic targets are displayed as diamonds with direction of flight and separation in hundreds of feet.

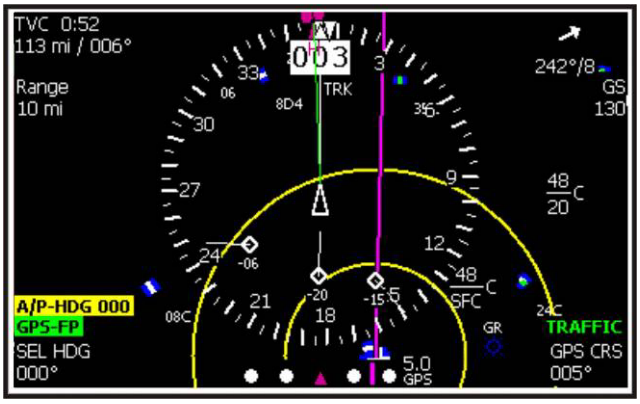


Fig 5-5 Traffic

5.8 Electronic Horizontal Situation Indicator

The Horizontal Situation Indicator (HSI) works just like a conventional HSI and is displayed in the **MAP** group when the GRT Sport is connected to a Garmin SL30.

Fig 5-6 EHSI

To access the MAP settings:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU**
4. Select **MOVING MAP** with either knob
5. Press to select

5.9 Flight Plan

The GRT Sport allows for quick and easy selection of a waypoint for **Direct To** navigation or a series of waypoints for flight **PLAN** destinations.

The **PLAN** pages, **DIRECT –TO** and **FLIGHT PLAN,** allow viewing of waypoint details, Primary Flight Display artificial horizon, airspeed and altitude, External flight plans, and copying and importing of flight plans. These functions are selectable using the right knob.

To view waypoint details:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob to select **DETAILS**
5. Press right knob to view

To turn on PFD artificial horizon, airspeed and altitude while in the PLAN page:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **PFD**
5. Press right knob to turn on or off

To use an external source for flight plans:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **EXTERNAL**
5. Press right knob to view
6. Press the button labeled **COPY** to copy it to the GRT Sport

To import a flight plan (any GPS format) from flight planning software on a USB stick:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **IMPORT**
5. Press button labeled **UP** or **DOWN** to select the desired flight plan
6. Press the button labeled **LOAD** to copy it to the GRT Sport

5.9.1 Select a waypoint as a destination

To select a waypoint as a destination:

1. From a **MAP** page, press the right knob.
2. Scroll to the desired waypoint.
3. Press right knob. The waypoint details will show
4. Press **NEXT**
5. Press **ADD WP.** The waypoint will be added to the Direct To list and be the active destination. The active destination is shown with a white arrow next to it.
6. Press **MAP** to go back to the **MAP** view. The course to the active destination is shown with magenta line from the current position.

5.9.2 Selecting the Nearest Airport

Within the Direct To page are functions which allow for selection of a nearby waypoint.

To view the list of nearest waypoints:

1. From a **MAP** page, press the right knob.
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**. This will take you to the Direct To page.
4. Press **NEAR**
5. Press **AIRPORT** or **NAVAID**

To select a near waypoint as a destination:

6. Scroll with either knob to desired waypoint
7. Press **GOTO**

The selected waypoint is now the active destination in the **Direct To** page.

5.9.3 Creating a new GOTO

The Plan page also allows you to enter an airport or navaid identifier in the **Direct To** page by hand.

The left knob controls a clear (**CLR**) function as well as **EXIT**. The **CLR** function removes the letter or number entered and backspaces the entry.

The **EXIT** function exits to the Direct To page.

The right knob controls the **NEXT** function which moves the cursor to the next space. The right knob also controls the **CREATE** function. This allows you to enter your own latitude and longitude data and make a **User WP**.

When selecting an airport or navaid the GRT Sport will automatically ask for the ICAO prefix identifier K (for North America) for the airport if it is required. If one has been entered but is not required the GRT Sport will suggest removing only the prefix identifier. A right knob selection, **REM K** will show. Similarly, if the prefix identifier K has been left off, the GRT Sport will suggest adding it. A right knob selection, **ADD K** will show.

To add or remove the prefix identifier:

Scroll to **ADD K** or **REM K** to add or remove K for the identifier.

To create a NEW DIRECT TO:

1. Press **NEW GOTO** from the Direct To page

Use the alpha-numeric buttons to enter the identifier for the airport or navaid.

2. Press the appropriate button to select the letter or number.

When pressing multiple times in the same column the cursor moves to the next letter in that column. When pressing a different column button the cursor automatically moves to the next space in the identifier field.

3. Press **ENTER** when complete

The GRT Sport PLAN will add it to the **DIRECT** -**TO** page or **FLIGHT PLAN** page.

5.9.4 Creating User Waypoints

You may also choose from user defined waypoints.

To create a User WP:

1. Press **User WP**
2. To add a new waypoint press **NEW**
3. To edit an existing waypoint press **EDIT**
4. To delete an existing waypoint press **DELETE**
5. To exit the **User WP** page press **EXIT**

5.9.5 Selecting a User Waypoint

Press **User WP** knob selection from the **Direct To** or **Plan** page.

When in the **FLIGHT PLAN** page the left knob controls the following page functions: delete waypoint (**Del WP**), select flight plan (**Sel FP**), reverse flight plan (**Rev FP**), save flight plan (Save), user waypoint selection (User WP), clear flight plan (Clr FP).

When a waypoint is selected on the Flight Plan button labels will appear. They are:

Insert Before
Clear FP
Direct To
Goto Leg
Exit

The **Insert Before** function will put the waypoint entered in front of the current selected waypoint.

The **Clear FP**, clear flight plan function will clear the plan from the screen.

The **Direct To** function allows you to set a waypoint in the flight plan as the active Direct To destination.

The **GoTo Leg** function will cause the GRT Sport to fly the next leg to the selected waypoint, skipping previous legs.

5.10 Terrain

The GRT Sport uses the terrain database currently available on the Grand Rapids Technologies website. Go to www.grtavionics.com/download for the latest version.

The colors displayed correspond to terrain as follows:

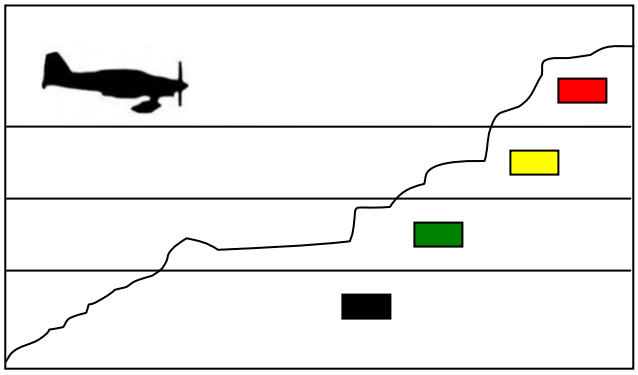


Fig. 5-5 Terrain Illustration

When terrain is less than 500’ feet below or above, RED
When terrain is more than 500 feet to 1000 feet below, YELLOW
When terrain is more than 1000 feet to2000 below, GREEN
When terrain is more than 2000 feet below, BLACK
Ocean coasts are shown in BLUE.

For terrain data not in memory or has not loaded yet is shown as BLUE DOTS.

To access Terrain settings:

1. Press any button followed by **NEXT**
2. Press **SET MENU**
3. Select Moving Map
4. Press knob

SECTION 6: ENGINE MONITOR

The Engine Monitor Display provides a graphical representation of the information from sensors attached to the Engine Information System (EIS). In this section we will show you the different pages and leaning function.

Fig. 6-1 Engine Monitor

Within the Engine page you may also select what data you would like to view as standard. Those page views are:

- Temps
- EGT
- History
- Bars
- Stats
- Dials

6.2 Temps Page

The Temps page shows CHT and EGT temperatures.

Fig. 6-2 Temperature Page

6.3 Exhaust Temperature Page

The **EGT** page shows Exhaust Gas Temperatures and is useful for leaning. The picture below shows the **EGT** page with the **LEAN** function **OFF**.

Fig. 6-3 EGT Page-LEAN OFF

With the **LEAN** function on the **ENG**/EGT page shows the first cylinder to peak surrounded by a white box. The last cylinder to peak is shown in a green box.

The numbers then shown are either positive ( ) or negative (-) representing the difference from peak.

To access the LEAN function:

1. Press any button in the ENG group
2. Press **LEAN**
3. Press **LEAN**, **NORM** or **OFF**

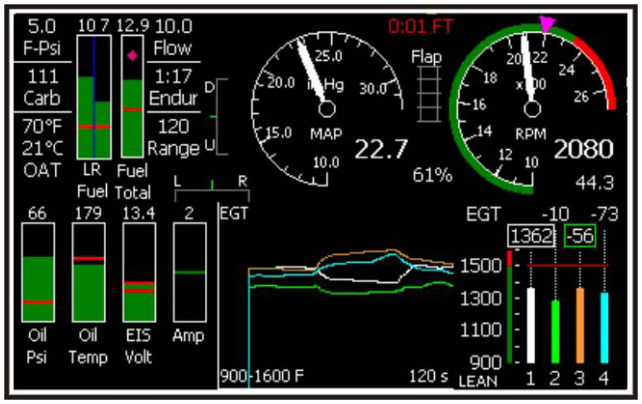


Fig.6-4 EGT Page-LEAN ON

The **LEAN NORM** function shows the difference between the cylinder temperatures from the time the **NORM** function is pressed.

The **LEAN** function will show the cylinders peak from first to last and their temperature difference from that point in time.

Fig. 6-5 EGT PAGE- NORM

The Engine History page provides 30-240 user selectable seconds of CHT and EGT history.

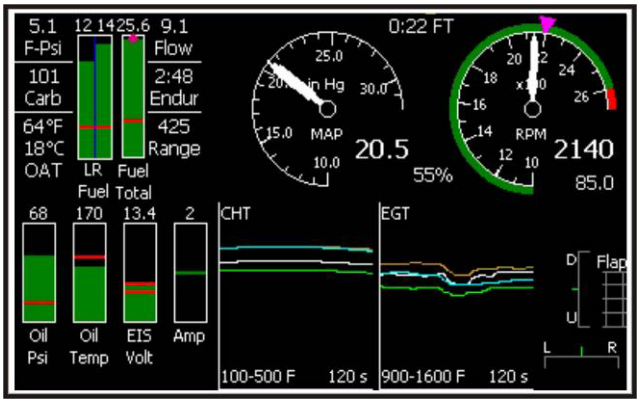


Fig. 6-6 Engine History

6.4 Engine Stats Page

The Engine Stats page provides a quick reference area for a number of different user definable parameters.

Fig 6-7 Engine Stats

6.5 Engine Dials Page

The Engine Dials page allows certain parameters to be viewed in a dial format. Below is an example of this page view.

Fig. 6-8 Engine Dials

It is also possible to watch the Engine page and the Moving Map at the same time.

To access this view:
Press any button followed by **ENG**

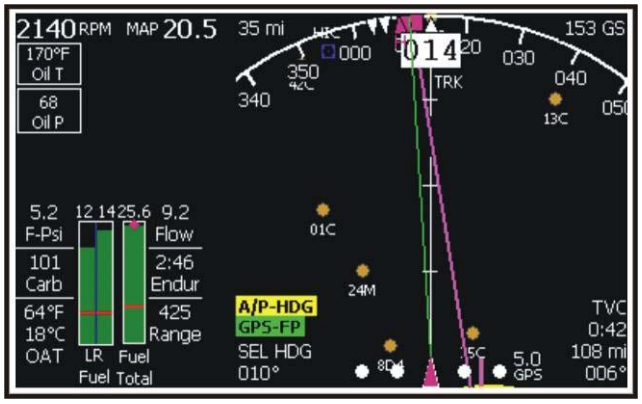


Fig. 6-9 Engine/Map

6.6 Engine Page Settings

There are two Setting Menus for the Engine Monitor Display page. The first is the Graphical Engine Display menu. It provides settings to customize the bar graphs and dials on the **ENG** page.

To access the Graphical Engine settings:

1. Press any button
2. Press **NEXT** (More than once may be required)
3. Press **SET MENU**.
4. Select **Graphical Engine Display** with either knob then
5. Press to select.

The second is the Engine Limits page menu. This page provides setting for all the parameters to be shown on the **ENG** page.

To access the Engine Monitor settings:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU**
4. Select **Engine Limits** with either knob then
5. Press to select

To access the Total Fuel function:

1. Press the left knob

The **Fuel** label will show the following:

OK
(Preset number)
(Preset number)
ADJ

The **OK** option will not make any changes. The top number and the one below it are fuel totals.

The top number is adjustable by selecting **ADJ**. When changed and accepted this new number will be kept in memory till it is changed by the user.

The one below is a preset fuel total in the **Graphical Engine Display** set menu. These numbers allow you to display preset fuel totals for selection.

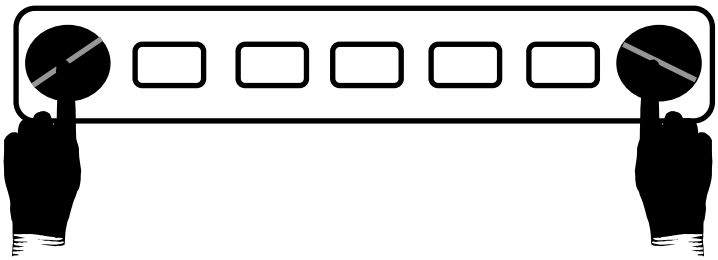
SECTION 7: A/P COUPLING

Now that you have an understanding what the GRT Sport is capable of displaying we will show you what the GRT Sport is capable of doing.

7.1 Lateral Coupling

The GRT Sport generates lateral autopilot commands to allow coupling of GPS sources or heading to the autopilot. The GRT Sport will provide these commands even if the autopilot itself does not support these modes.

To select the current heading:
Press both knobs simultaneously.



Autopilots that do not include GPSS typically include an interface which allows them to follow the GPS flight plan.

The GRT Sport uses this interface, and sends out data in the GPS format to control the autopilot. This requires the autopilot to be in **flight plan** mode.

> **NOTE:** The autopilot must be in the mode that allows it to follow a GPS flight plan as if it was connected to a GPS.

The intercept angle to the localizer is controlled by the autopilot, and will usually be fixed at 45 degrees.

7.2 Autopilot Mode

In the GRT Sport will couple the autopilot in lateral mode.

LAT A/P

The Lateral Autopilot, **LAT A/P** selection allows you to couple the lateral steering of the autopilot to the heading bug (**HDG**), or the GPS receiver (**NAV**) from the **PFD** page.

To select LAT A/P - HDG:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **LAT A/P HDG**.

To select LAT A/P - NAV:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **LAT A/P NAV** button

7.2 The Synthetic Approach Path

Lateral steering for the synthetic approach is constructed by the GRT Sport according to the following list, in order of priority.

1. If an approach has been selected on the GPS, the synthetic approach path will match the course into the runway waypoint. (An approach is a flight plan that includes guidance to the runway, and will include a runway waypoint, such as RW25.)
2. If no approach has been selected on the GPS, but the last waypoint in the flight plan is an airport, the pilot will be prompted to select the runway. If the runway includes a localizer in the GRT Sport database, then the

approach will be constructed to mimic the localizer, otherwise it will be constructed to follow the extended runway centerline.

3. If no approach has been selected, and the last waypoint in the GPS flight plan is not an airport, the synthetic approach is not available.

Selecting the Synthetic Approach

The approach mode is selected on the primary flight display page, using the **SAP** button. Select **SAP** to **ARM** the approach mode. An approach will be provided if all of the following is true:

- The last waypoint in the flight plan is an airport, and is contained within the GRT Sport navigation database, or if an approach has been selected and the GRT Sport is able to determine the airport and runway being used by the approach.

- The database contains the necessary information about this airport, including runways, runway orientation, position, elevation, etc.

- AHRS/Air Data and GPS data are valid.

7.3 Automatic Runway Selection

If an approach has been selected in the GPS flight plan, and the GRT Sport is able to determine the airport and runway for this approach, a message will be generated confirming the runway selected by the GPS approach was identified (For example, **Synthetic App using 26L at KGRR**).

7.4 Manual Runway Selection

If an approach has not been selected on the GPS, and the last waypoint in the flight plan must be an airport. The GRT Sport will then provide a list of the available runways. The desired runway is selected using the left knob. This list shows the runway identifier, the length, surface (hard or soft), lighting, and crosswind component. The crosswind component is shown as X-Wind = speed L/R, where the speed is in the units selected on the GRT Sport, and the L/R indicates a left or right crosswind, such that a left crosswind indicates the wind is blowing from left to right when on the approach. The GRT Sport will list the runways in order of how closely aligned they are with the calculated wind direction. Runways that are predicted to have a greater than 10 mph tailwind are shown with a yellow background.

After selecting a runway, it may be changed by using the **SAP** button again. It will provide a **Chg Rwy** selection.

CAUTION: The pilot must not rely on this data for selection of the appropriate runway. Wind speed and direction is usually different on the surface. The EFIS SPORT is making its prediction based on its calculated winds at the time the approach mode is activated. The accuracy of the wind calculation is affected by the accuracy of the pitot/static measurements, and the calibration of the magnetometer.

If the selected runway includes an associated localizer in the GRT Sport navigation database, the message **Synthetic Approach using Loc Course** will be provided to remind the pilot that the approach will follow the localizer, and my not

necessarily be aligned with the runway centerline.

If the approach mode is selected, but the GPS flight plan does not contain an approach or an airport as the last waypoint that can be matched to the GRT Sport database, then the synthetic approach cannot be activated. The GRT Sport will respond with a message **No Airport found for Synthetic App**, and the approach mode will be turned off.

7.5 Transitioning from Enroute to Synthetic Approach

If an approach has been selected in the GPS flight plan, the transition from enroute to a path that aligns the airplane with the runway will be inherent in the GPS flight plan. The synthetic approach will be considered **captured** (causing the synthetic approach HITS to be displayed) when the airplane is within 2.5 degrees of the synthetic approach course, and within 20 nm of the runway threshold, emulating the typical capture of a localizer.

If no approach has been selected on the GPS flight plan, the GRT Sport will override the GPS flight plan or HDG selection to turn the airplane onto the extended runway centerline. This will typically occur when the airplane is within 2.5 degrees of the extended runway centerline, and within 20 nm of the runway threshold. A message **Synthetic Approach Captured** will be displayed when this transition occurs, and the GPS CDI, and course indicator will then be driven by the synthetic approach, as well as the autopilot.

If capture of the synthetic approach is attempted close to the runway, the GRT Sport will try to predict when it must begin turning onto the synthetic approach course based on groundspeed and intercept angle so that it does not overshoot the course. Since the response of the autopilot and airplane can not be predicted perfectly, overshoot is possible, and some loss of accuracy in the initial tracking of the synthetic approach may be expected. The following diagram illustrates the synthetic approach capture criteria.

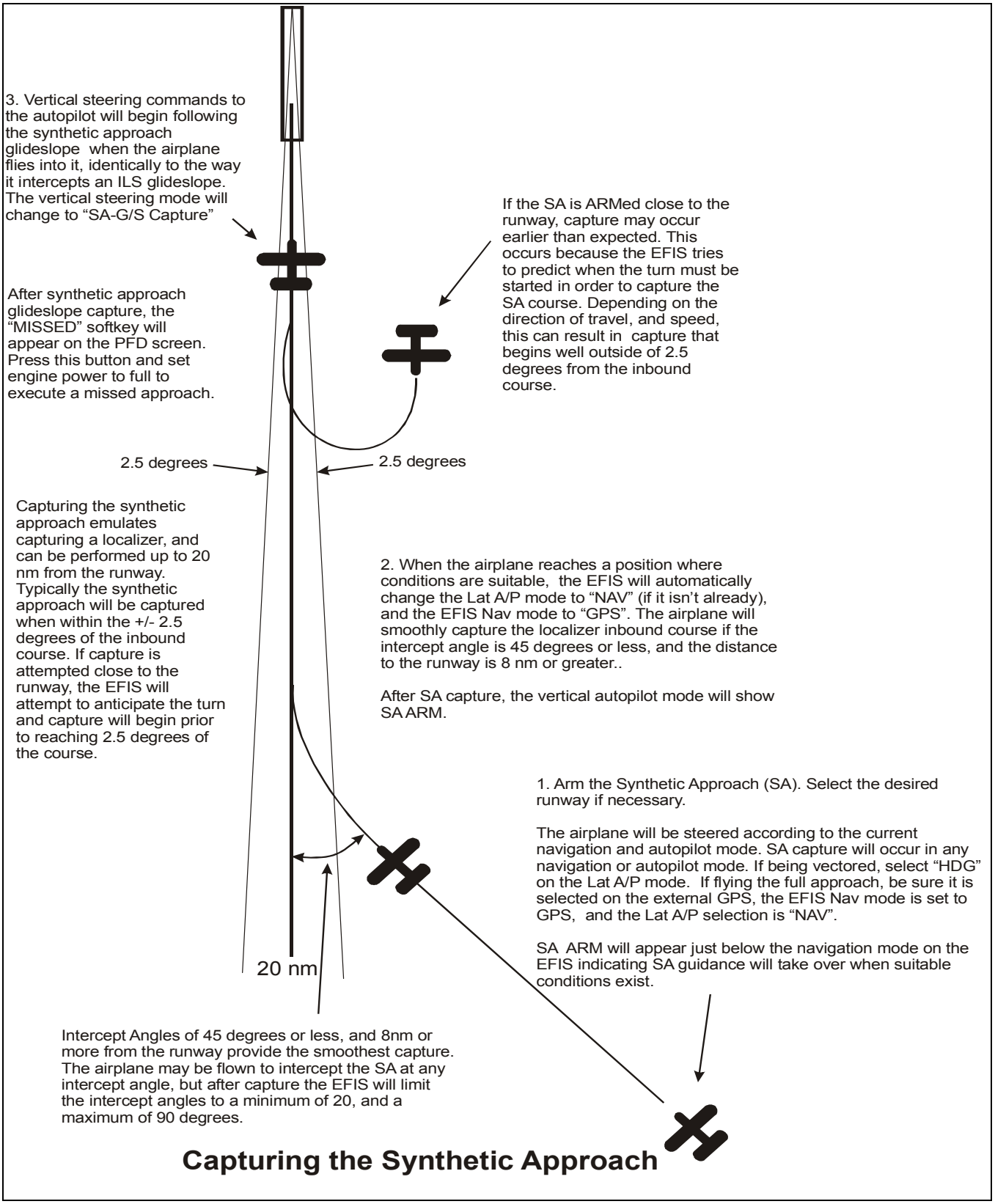

3. Vertical steering commands to the autopilot will begin following the synthetic approach glideslope when the airplane flies into it, identically to the way it intercepts an ILS glideslope. The vertical steering mode will change to "SA-G/S Capture"
If the SA is ARMed close to the runway, capture may occur earlier than expected. This occurs because the EFIS tries to predict when the turn must be started in order to capture the SA course. Depending on the direction of travel, and speed, this can result in capture that begins well outside of 2.5 degrees from the inbound course.
After synthetic approach glideslope capture, the "MISSED" softkey will appear on the PFD screen. Press this button and set engine power to full to execute a missed approach.
2.5 degrees
2.5 degrees
Capturing the synthetic approach emulates capturing a localizer, and can be performed up to 20 nm from the runway. Typically the synthetic approach will be captured when within the +/- 2.5 degrees of the inbound course. If capture is attempted close to the runway, the EFIS will attempt to anticipate the turn and capture will begin prior to reaching 2.5 degrees of the course.
2. When the airplane reaches a position where conditions are suitable, the EFIS will automatically change the Lat A/P mode to "NAV" (if it isn't already), and the EFIS Nav mode to "GPS". The airplane will smoothly capture the localizer inbound course if the intercept angle is 45 degrees or less, and the distance to the runway is 8 nm or greater..
After SA capture, the vertical autopilot mode will show SA ARM.
1. Arm the Synthetic Approach (SA). Select the desired runway if necessary.
The airplane will be steered according to the current navigation and autopilot mode. SA capture will occur in any navigation or autopilot mode. If being vectored, select "HDG" on the Lat A/P mode. If flying the full approach, be sure it is selected on the external GPS, the EFIS Nav mode is set to GPS, and the Lat A/P selection is "NAV".
SA ARM will appear just below the navigation mode on the EFIS indicating SA guidance will take over when suitable conditions exist.
20 nm
Intercept Angles of 45 degrees or less, and 8nm or more from the runway provide the smoothest capture. The airplane may be flown to intercept the SA at any intercept angle, but after capture the EFIS will limit the intercept angles to a minimum of 20, and a maximum of 90 degrees.
Capturing the Synthetic Approach

Fig. 7-1 Synthetic Approach Capture

7.6 Altitude Presets

The GRT Sport has one altitude preset, Decision Altitude.

The altitude window will show on the display and blink. Waiting 5 seconds allows the number to be changed by tens of feet.

To set the DECISION ALTITUDE:

1. Press **PFD** button
2. **NEXT** button (more than once may be required)
3. Press **SET DA** button
4. Press the right knob, **SET**

To clear a DECISION ALTITUDE:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **SET DA** button
4. Press **CLEAR** button

Section 8: Equipment Interface

The Sport will interface with the Garmin SL series radios and Garmin transponders and a variety of trim/flap sensors. This section will cover equipment GRT recommends for using with the Sport

8.1 Garmin SL30/40 Radio

The GRT Sport will interface with the SL30 Nav/Com and SL40 Com exclusively. Using these radios the GRT Sport will auto-tune the Nav/Com and provides the HSI in the **MAP** group, HSI page.

8.2 GTX 327/GNX330 Transponder

For the Garmin line of transponders to work properly with the Sport the transponder must be configured in the following manner.

Configuring the GTX 327

Refer to the GNX327 installation manual.

Configure serial input 1 for the FADC w/ALT format

Configuring the Sport Display Unit

To find the Settings Menu:

1. Press any button or knob
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU**
4. Use either knob to scroll to **General Setup**
5. Press knob to select
6. Scroll to Serial Port 2
7. Change the Output to Fuel/Air Data (Z Format)
8. And set the Serial Port 2 Rate to 9600

Configuring the GNX 330

Refer to the GNX330 installation manual.

1. Configure serial input 1 for the FADC w/ALT format

Configuring the Sport Display Unit

To find the Settings Menu:

1. Press any button or knob
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU**
4. Use either knob to scroll to **General Setup**
5. Press knob to select
6. Scroll to Serial Port 2
7. Change the Output to Fuel/Air Data (Z Format)
8. And set the Serial Port 2 Rate to 9600

SECTION 9: CALIBRATION

Now that your system is working and communicating with the GRT Sport we want to make sure the information it receives is accurate. The following steps will help you accomplish this goal.

9.1 Altimeter Calibration

The accuracy of the altimeter can be adjusted using entries provided on this page to account sensor errors that may occur due to aging.

The adjustments are stored within the AHRS/Air Data Computer. This means that is not necessary to enter these corrections into other display units that use data.

Partial Altimeter Calibration – Correcting Altitude vs. Baroset

This calibration adjusts the relationship between the altitude display, and the barometric pressure setting. This calibration does not require an air data test set, and may be performed on an annual basis, or as needed as follows:

1. Position the aircraft at a location with a known elevation.
2. Turn on the GRT Sport and AHRS, and allow at least 5 minutes to elapse before continuing.
3. Obtain the current barometric pressure setting. This setting should be provided by the airport at which the airplane is located, or a nearby airport, and should be as recent as possible.
4. Select the **Altimeter Calibration** screen by selecting **SET MENU** from the button menu and **Altimeter Calibration** from this menu.
5. Using the left knob, highlight the **Altimeter Calibration – OFF** selection.
6. Toggle this to (**Initiate**)**ON**.
7. Set the baroset to the currently reported altimeter setting.
8. Select **Altimeter Bias**. Adjust the setting until the altimeter matches the airport elevation. (Note that there is about a 2 second delay until adjustments are reflected in the displayed altitude.)
9. Use the buttons to exit.

Calibration is complete! Do not alter any other altitude settings. The altimeter calibration will be turned off automatically when this page is exited.

Full Altimeter Calibration – Using an Air Data Test Set

This calibration adjusts the relationship between the altitude display, and the barometric pressure setting using an Altimeter Test Set.

1. Turn on the GRT Sport and allow at least 5 minutes to elapse before continuing.
2. Connect test set to the pitot AND static ports of the AHRS.
3. Set the test set to sea level (0').

NOTE: Failure to connect the test set to the pitot connection will damage the airspeed sensor in the AHRS, and any mechanical airspeed indicators which are also connect to the pitot/static system under test.

4. Set the baroset to 29.92 on the GRT Sport display unit. Turn the right knob to set baroset.
5. From the display unit which controls (has a serial output to) the AHRS select the **Altimeter Calibration** page in the **Settings Menu**
6. Verify the baroset is 29.92.
7. Use the left knob to select (blue box) and press the knob to highlight (white box) the **BIAS** field.
8. Temporarily adjust the **BIAS** on this page until the altimeter reads 0'.
9. Set the altimeter test set to 30,000'
10. Note the GRT Sport altimeter reading.
11. Calculate the scale factor as follows:

Calculate the Altitude Error as:
Altitude_Error =
GRT Sport_Altimeter_Reading 30,000.

If the GRT Sport altitude is too low (the Altitude_Error is negative):

Calculate the Pressure_Error by multiplying the Alitude_Error by 0.819. The result will be a negative number.

If the GRT Sport altitude is too high (the Altitude_Error is Positive):

Calculate the Pressure_Error by multiplying the Alitude_Error by 0.795. The result will be a positive number

The scale factor is then calculated as follows:

Alt_Scale_Factor = 42012 / (42012 + Pressure_Error)

The result should be a number greater than 0.9744, and less than 1.0255

Set the Alt_Scale_Factor as calculated.

(Current GRT Sport software may show **ERROR** next to **Calibrate**. This can be ignored.)

1. Set the altimeter test set back to sea level (0')
2. Set the BIAS so that the altimeter reads 0'.
3. Complete the calibration by setting the altimeter test set to each altitude listed on the calibration page (5000, 10000, 15000, etc.), and adjusting the corresponding entry until the altimeter reads this altitude.

The accuracy of the scale factor adjustment can be verified by noting a small altitude error (less than 200 feet) is observed with a zero correction at 30,000 feet.

4. Adjust the 30,000 foot correction until the altimeter reads 30,000 feet.
5. Exit the calibration page.
6. Calibration is complete.

If necessary, the **BIAS** adjustment can be made without affecting the other corrections at any time.

9.2 Magnetometer Calibration

Magnetometer calibration is required to achieve accurate magnetic heading readings. This calibration corrects for errors induced by magnetic disturbances local to the sensor, such as ferrous metal objects.

Before performing this procedure, the magnetometer location should be validated as follows:

Magnetometer Location Validation

1. Select **AHRS Maintenance**, and locate the Magnetic Heading field on this screen. This shows the magnetic heading data provided by the magnetometer. (The heading data shown on the normal display screens is the gyro slaved heading, which responds slowly to magnetic heading changes.)
2. Observe this reading and verify it does not change by more than +/- 2 degrees while doing the following:
3. Turn on and off any equipment whose wiring passes within 2 feet of the magnetometer. Move the flight controls, if the magnetometer is located near retractable landing gear, operate the landing gear.

Before performing the magnetometer calibration procedure, the approximate accuracy of the uncorrected magnetic heading data must be checked.

1. Face the plane in the 4 cardinal headings, North, East, South and West.

While the calibration procedure can remove errors as large as 125 degrees, accuracy is improved if the location chosen for the magnetometer requires corrections of less than 30 degrees.

Note: The magnetometer must be installed according to the mounting instructions provided with the magnetometer.

Calibration Procedure

The **Magnetometer Calibration** page will guide you through this procedure with its on-screen menus.

The steps you will follow are:

1. Point the aircraft to **magnetic** north, in an area without magnetic disturbances, such as a compass rose.

NOTE: The AHRS will not allow magnetometer calibration to be initiated if the airspeed is greater than 50 mph to prevent inadvertent selection while in flight. If calibration is successful, the existing calibration data (if any) will be replaced with the new corrections.

NOTE: Be sure your GPS is displaying MAGNETIC track, not TRUE track, if using it to align the airplane with magnetic north.

A simple means of pointing the airplane toward magnetic north is to taxi the airplane slowly and use the GPS ground track to determine when you are taxiing in a magnetic north direction.

Make small corrections to the direction of travel of the airplane, and continue to taxi for several seconds for the GPS to accurately determine your ground track. The GPS cannot determine your track unless you are moving.

2. After the aircraft is positioned accurately, turn on the GRT Sport. (If it was already on, then turn it off, and then back on again.)

3. Allow at least 1 minute for the AHRS to fully stabilize.
4. Activate the magnetometer calibration function by selecting the **Maintenance Page**, and highlighting the **Magnetometer Calibration** selection.
5. Change this setting with the knob to select the magnetometer calibration page.
6. Press **Start**.
7. Answer the question, **Yes.**
8. Verify the airplane is still pointed to magnetic north, and answer the question **Is the airplane, AHRS, and magnetometer pointed north?** with **Yes**.

A message will appear at the bottom of the screen indicating the system is waiting for the gyros to stabilize.

9. Wait until this message is replaced with the message, **Calibration in Progress**, and immediately (within 15 seconds) begin the next step.
10. Rotate the aircraft 360 degrees plus 20 degrees in a counter-clockwise manner (initially towards west).

The airplane does not need to be rotated in place, but simply pulled or taxied in a circle. The airplane must be rotated completely through 360 degrees, plus an additional 20 degrees past magnetic north, within 3 minutes after initiating the calibration. The airplane should be rotated slowly, such that it takes approximately 60 seconds for the complete rotation.

If calibration is successful, the AHRS will re-start itself automatically, and begin using the corrections. While re-starting, the AHRS data will not provide data, and this will result in the AHRS data disappearing from the display unit for about 10 seconds.

If calibration is unsuccessful, one of two things will happen.

a. It will exit calibration mode, and will show **Calibration INVALID - Maximum correction exceeded** if a correction of greater than 127 degrees is required. (**Invalid - OVERLIMIT** will be shown on the AHRS maintenance page next to the Magnetometer Calibration field.

A correction of greater than 127 degrees can be caused by incorrect mounting of the magnetometer, or location of the magnetometer too close to ferrous metal in the aircraft, or starting with the airplane not pointed toward magnetic north.

b. If the airplane is rotated too rapidly, the calibration will not end after the airplane has been rotated 380 degrees. In either case, the calibration procedure must be repeated.

The accuracy of the magnetometer calibration can now be verified.

1. Point the airplane toward magnetic north.
2. Turn on the AHRS (if already on, turn it off, and then back on).
3. Verify the AHRS shows a heading close to north. (Small errors are likely to be a result of not positioning the airplane to the

exact heading used during magnetometer calibration.)

4. Select the **Magnetometer Calibration** page. (Do not activate the calibration this time.)
5. Rotate the airplane through 360 degrees, and inspect the **Calculated error** graph (the red line) drawn on the screen.

The magnetic heading errors should be less to 5 degrees, and can typically be reduced to about 2 degrees. Accurate magnetic heading is required for the AHRS to display accurate heading data, and to allow accurate wind speed/direction calculations. The graph will also show the correction stored in the AHRS as a green line. The green line will be within the +/- 30 degree range if the magnetometer was mounted in a good location, and was mounted accurately with respect to the AHRS.

The status of the magnetometer correction data is indicated by the field next to the **Magnetometer Calibration** setting on the **AHRS Maintenance** page, if the field has the message **(Change to open page)**, then valid data is stored within the AHRS.

Calibration is complete.

Valid data means that the data is present, but the accuracy of this data is not assured. The accuracy is dependent on how carefully the user performed these steps.

Magnetic Heading Accuracy

To check the accuracy of the uncorrected magnetic heading:

1. Scroll to **Magnetometer Calibration**
2. Press knob to select
3. While on this page, rotate the airplane 360 degrees. A red graph will appear on this page showing the errors showing the calculated errors.

If errors of greater than 30 degrees are observed, this may be caused by magnetic disturbances near the magnetometers, such a ferrous metal, magnetic fields from electric motors, or if the magnetometer orientation is not the same as the AHRS. (For every 1 degree of misalignment between the magnetometer and the AHRS, approximately 3 degrees of heading error can be expected.)

9.3 True Airspeed and Wind Calibration

The GRT Sport accurately calculates indicated airspeed via its measurement of the difference between pitot and static pressures.

Typical instrument errors are less than 2 mph at 100 mph, and diminishing to less than 1 mph at 200 mph. It is not uncommon for airspeed errors to be observed however, as the pressures provided by the aircraft's pitot/static system does not always represent the actual static and impact pressures.

The GRT Sport provides a means of correcting the true airspeed that it displays in the PFD data box, and which is used in the wind calculation. Since the wind calculation is based on the difference between GPS groundspeed, and true airspeed, it is quite sensitive to true airspeed errors, and a significant improvement in the accuracy of the winds can be achieved by performing this calibration for some airplanes.

The GRT Sport does not provide any means to correct the indicated airspeed, as this would result in the GRT Sport showing a different indicated airspeed than other indicators that may be installed in the airplane.

The **AHRS Maintenance** page provides a **True Airspeed Corrections** selection. When selected, a correction table is shown, over-laid on the PFD screen. The table allows for up to 8 corrections. It is recommended that at least 3 airspeeds be used for the corrections, as follows: correction at the typical cruising speed, typical climb airspeed and typical approach speed. For example, with an RV-6, a good approach speed might be 80 mph with flaps at 1 notch. Additional corrections as desired can be entered, especially if TAS errors are noted that vary significantly with speed. Only one correction for a specific airspeed should be made.

To record a TAS correction:

1. Press any button or knob.
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU** button
4. Scroll with either knob to **AHRS Maintenance**
5. Scroll to **True Airspeed Corrections**
6. Press knob to select
7. Turn knob to open calibration page
8. Select a blank table entry in the correction table using a knob.

If no entries are blank, then select an entry and press **Delete** to clear the entry. The **Start Cal** button will be displayed when the cursor box is on a blank entry.

9. Press the **Start Cal** button to begin.
10. Find a heading such that the ground track indicator is aligned with the heading indicator on the PFD or map pages within 5 degrees. This will result in the airplane flying directly into, or with the wind.
11. Establish the desired IAS for the correction. Do not change the power setting until the calibration is complete.
12. Press the **Ready** button.

The GRT Sport will average the data until the on-screen count-down timer reaches 0.

13. Maintain constant heading and altitude until the count-down timer reaches 0.
14. Turn to the reciprocal heading when prompted.
15. When established on this heading, at the same altitude and power setting as in step 2, press the **READY** button.

The data will be collected until the count-down timer reaches 0. The correction table will then display this correction.

16. Process is complete

If you feel that an entry is inaccurate, it may be deleted by selecting it with the cursor box using the knob, and pressing the **DELETE** button. You will be asked to confirm deletion of this entry before it is erased.

These entries can be saved using the **GRT Sport Settings Backup** selection on the display unit maintenance page. They

may also be manually entered if desired using the **EDIT** function.

9.4 Flap/Trim Calibration

See **General Setup**, **Flaps and Trim Calibration**. This setting assumes electric flap/trim servos are installed.

9.5 Post Installation Checkout Procedure

The intent of this procedure is to verify each electrical connection to the GRT Sport has been properly made. This is accomplished by operating the GRT Sport, and the equipment which connects to it and observe responses that indicate the various connections.

Clearly the exact checkout procedure will be dependent on the exact configuration of the GRT Sport, and thus the following tests are provided as a basis from which the installer may wish to expand upon.

1. Apply power to the display unit(s).
2. Verify they start up and show the startup page.

If multiple buses provide power to the display unit, verify each bus is able to power the display unit(s).

3. Apply power to the AHRS.
4. Verify communication with the AHRS by observing that attitude data is provided on the primary flight display page.

If multiple buses provide power to the AHRS, verify each bus is able to power the AHRS. This verifies power connection, and serial input from the AHRS.)

5. Select the **Set Menu**, **AHRS Maintenance** on the display unit which controls the AHRS.
6. Verify the software version is displayed. This verifies power is power connection from each bus. While on the **AHRS Maintenance** page, locate the Magnetic Heading field on the Primary Flight Display.
7. Verify the magnetic heading is reasonable.
8. Change the heading of the airplane by about 90 degrees and verify the heading changes, and again is approximately correct.
9. Verify operation of the magnetometer with the aircraft in the North heading.

10. Apply pressure to the pitot system and verify the airspeed on the GRT SPORT responds.

CAUTION: Applying pressures greater than 1.5 psi may damage the AHRS and/or other equipment connected to the pitot system.

11. Vary the static pressure and verify the altimeter responds.

This verifies static port connection.

12. If a GPS is connected, turn it on.
13. Set the navigation mode to GPS, and verify the navigation mode is displayed as **GPS**, and not **GPS-HDG XXX**, which would indicate no GPS data being received.
14. Alternatively, select the MAP page on the GRT Sport display

unit. Select a map range of at least 50 miles.

15. Verify the map shows data, such as airports, navaids, etc. This verifies communication with GPS.
16. If the EIS is connected, turn it on.
17. Select the engine page on the GRT Sport, and verify the tachometer display is not dashes. This verifies communication with the EIS engine monitor.)
18. If localizer and glideslope data is provided to the GRT SPORT, verify it is displayed properly by selecting a test mode on the navigation radio, or by using an ILS test set.
19. Verify the accuracy and sense (direction) of the indications on either the primary flight display, or the H.S.I. page. Note: Some navigation receivers do not provide test data on their digital bus. This verifies analog localizer and glideslope connections.
20. Similarly validate all other interfaces, such as the connection to the autopilot, data provided by the ARINC 429 data, and any analog inputs that may be wired into the GRT Sport. This verifies all other connections.
21. Verify inter-display unit communication by setting the altimeter on any display unit, and verifying all other display units reflect the new setting.
22. Verify all analog connections to the GRT Sport. This requires selecting test modes for the various pieces of equipment that connects to these inputs. The state (voltage level) of these inputs is observed by selecting **Display Unit Maintenance**, and then **Analog Inputs** menu.

9.6 Fuel Flow Totalizer Calibration

The fuel flow totalizer (fuel quantity) can be set on the EIS engine monitor, or the GRT Sport display unit.

If the EIS is mounted in the instrument panel, it is used to set the fuel quantity whenever fuel is added to the airplane. This data will be transmitted to, and displayed on all display units to which it is connected.

If the EIS is not mounted in the instrument panel, the fuel quantity can be set on any display unit, but only if the fuel quantity in the EIS is reporting zero fuel. If the display unit detects a change in the fuel quantity reported by the EIS fuel flow function, it will use this data, overriding the user selection made on the display unit.

By setting EIS fuel quantity to zero, it assures the EIS reported fuel quantity will not change.

The fuel flow calibration must be set in the EIS, via its **FloCal** entry. See *EIS* manual for more detail.

9.7 Multi-Display Unit Communication

The display units share information; this allows user selections that affect the entire system to affect all display units, such as the altimeter setting for instance.

The following items are updated in all display units whenever this data is changed in any display unit.

- Altimeter Setting

- Heading Selection
- Selected Altitude
- All autopilot modes and selections, including ARMing of approaches
- Navigation Mode
- Synthetic Approach On/Off
- Fuel Flow Totalizer
- Alarm Acknowledgements

Other data may also be shared between display units using the Inter-Display Link menu on the General Setup screen. See the section User Settings, **General Setup**, for more information.

NOTE: General Settings must be made and verified on each display unit. These do not update across the Inter-Display Link.

CAUTION: If any display unit in the chain is inoperable, the display units will not be able to share information. The pilot must account for this down-graded mode of operation as necessary and expect data will not transfer between displays.

APPENDIX A: SPECIFICATIONS

PHYSICAL

Display Case Size: 6.25”W x 4”D x 4.65”H
Face plate Size: 7.25” W x .375” D x 4.75”H
Unit Weight: 2.25 lb.

Magnetometer Size: 5.125” W x 2.8”D x 1.125” H
Unit weight: .25 lb

EIS Size: 5.125” W x 2.375” D x 2.375” H
Face Plate Size: 5.94”W x .125”D x 2.75”H
Unit Weight: .9 lb.

POWER

Input: 12 Vdc (9-18V, 1.5 amps)
28 Vdc (optional) (18-36V, 1.0 amp)

INTERFACES

RS-232 serial

APPENDIX B: MOUNTING DIAGRAMS

The following diagrams show the size and mounting holes for the GRT Sport and magnetometer. NOT TO SCALE, dimensions in inches.

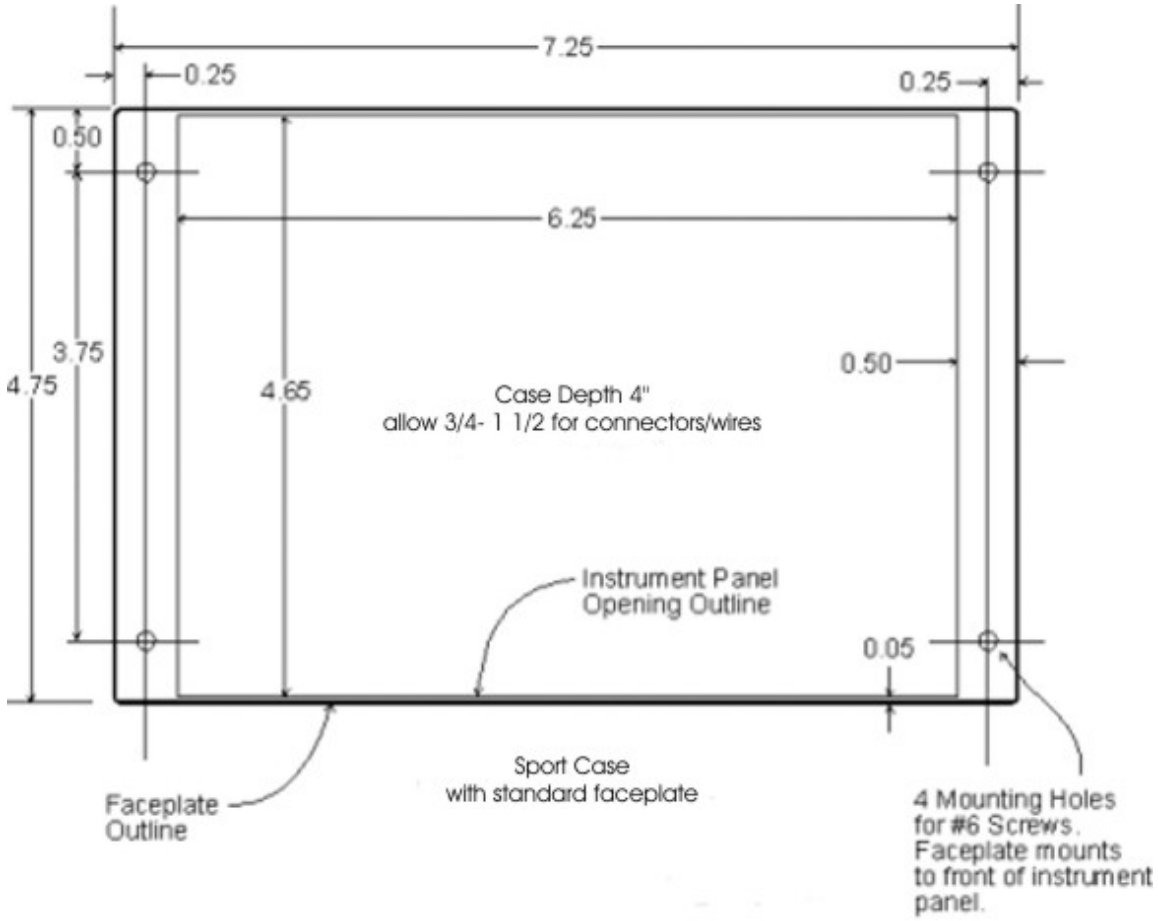


Fig. B-1 Standard GRT Mounting

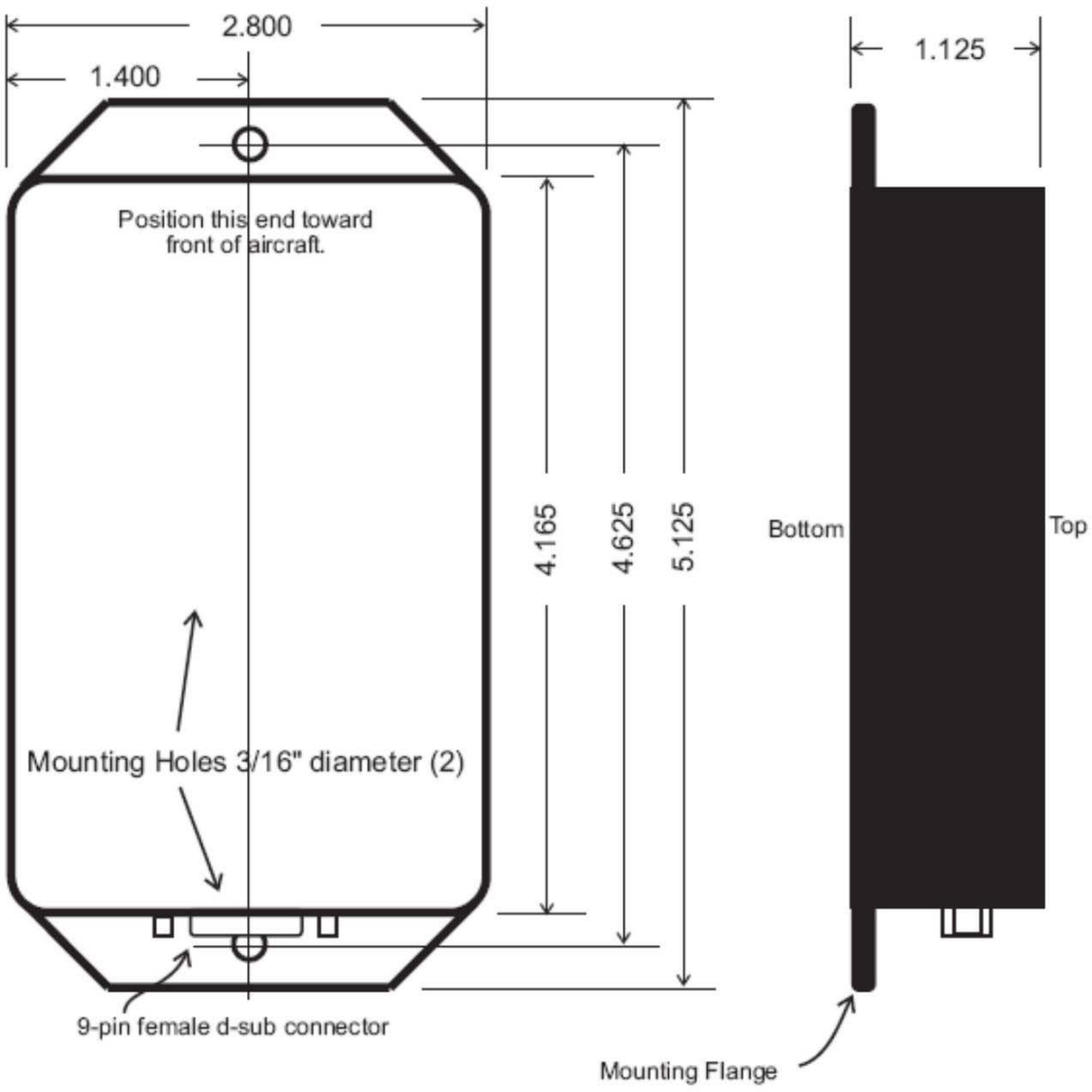


Fig. B -2 Magnetometer Mounting

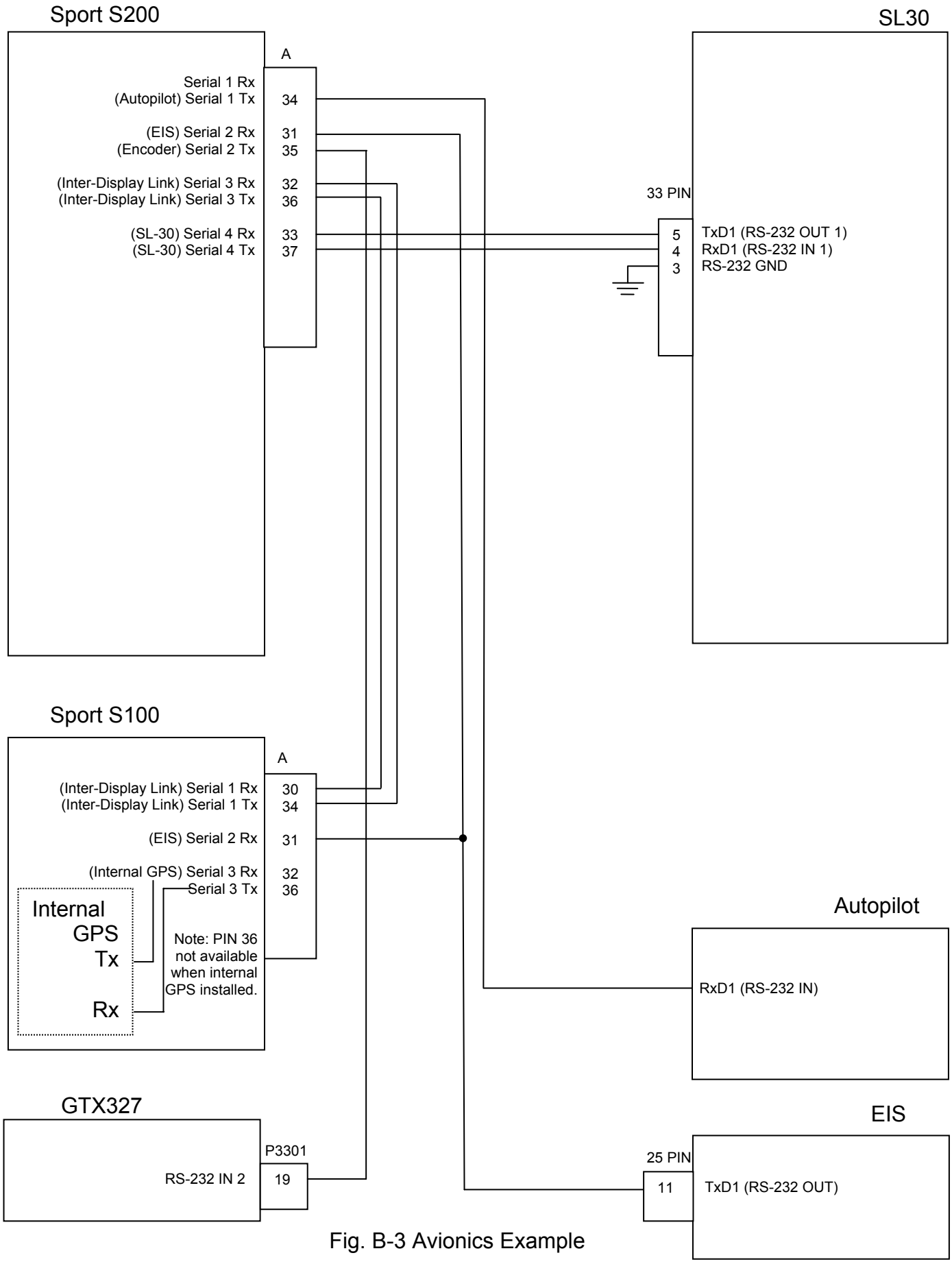
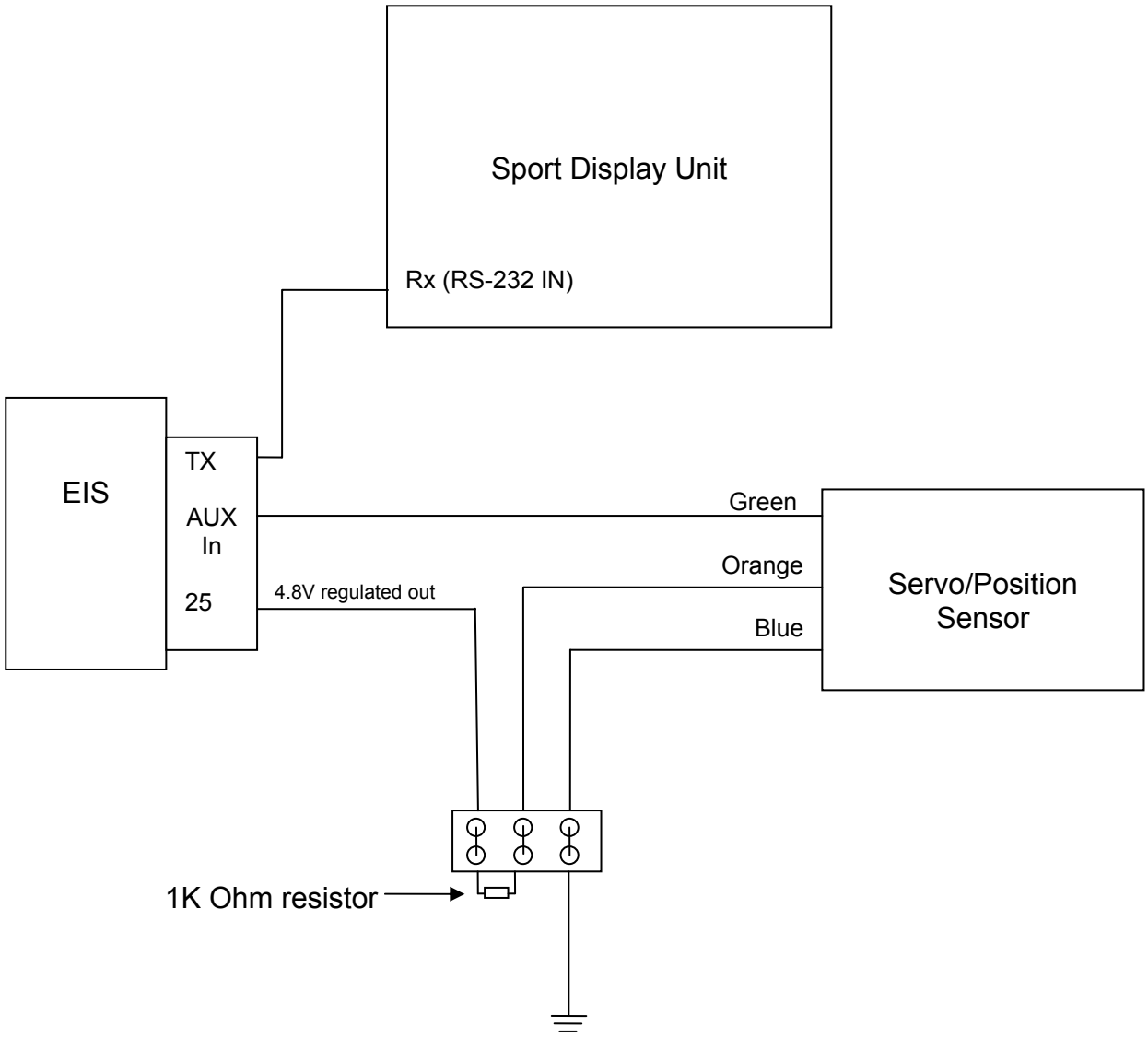


Fig. B-3 Avionics Example



Servo/Position Sensor
Installation

APPENDIX C: FAQ

What is the difference between the GRT Horizon and Sport?

The Horizon is built for Instrument Flight Rules (IFR) flying. It accepts a wide variety of radios, gps and autopilots. The autopilot command functions built into the Horizon allow for lateral and vertical coupling to the autopilot. This permits "hands-off-stick" flying much like current and future technology airliners.

The GRT Sport is much like the Horizon although tailored to the Visual Flight Rules (VFR) pilot. It will communicate with a Garmin SL30/40 radio and provides lateral autopilot commands. The AHRS/Air Data computer is physically inside the Sport instead of external like the Horizon. The Sport has limited inter-display link features.

If you like to fly hard IFR with an automated cockpit your choice will likely be the GRT Horizon. If you fly on fair weather days mostly with occasional light IFR your choice will likely be the GRT Sport.

What do I do if I want to upgrade to the Horizon?

All we require to upgrade to the GRT Horizon is the cost difference, send the Sport back and we will ship a Horizon in its place.

What do I need to upgrade to internal GPS?

All we require is the cost difference for the internal GPS option. Send us the Sport display unit and we will return the Sport with internal GPS installed and antenna.

Why a wide format display?

The wide format of the display was chosen to allow a more natural sense of the horizon, this especially useful for low-time IFR or VFR pilots. The wide format is necessary to allow split screen displays. It also allows for airspeed and altitude tapes to include analog and digital representations.

Why was the overall size chosen?

The overall size is such that two will fit, stacked on top of each other, in the RV and similar panels. This allows a great deal of flexibility, yet is still large enough to be easily readable.

Why not save the cost of the magnetometer, and make this optional?

Without a magnetometer, GPS data is required for calculation of attitude. Bad or loss of GPS data would cause unexpected loss of attitude data, and would reduce the integrity of the attitude data, and would reduce the performance of the GPS/AHRS cross-check.

Why not build the EIS into the GRT for its engine monitoring functions?

- The EIS provides a full time, easy-to-read display of engine data. This makes a single GRT display unit completely practical. Without the EIS, a second GRT

display would be required to allow full time display of engine data.

- Engine monitoring requires numerous connections to the engine and its sensors. Each of these connections is exposed to high levels of electrical noise, and has the potential of electrical faults introducing unexpected voltages to them. Bringing signals of this type into the GRT has the potential for adversely affecting the GRT, and thus reducing its integrity.
- The EIS provides a convenient backup for altitude and airspeed data if desired.
- For multiple display screen configurations, the EIS may be remotely mounted.

How does this GRT compare with the other EFIS systems?

There are 3 “levels” of differences.

The First Level

The obvious differences are the size and functionality.

This size of the display unit is large enough to allow the artificial horizon to look "natural", that is, like a synthetic view of the outside world (complete with airports and obstructions), and still have room for both tapes and large digital displays of airspeed and altitude.

At the same time, the size is is small enough to allow multiple display screens. Since each multi-function display unit can display any data (primary flight data, moving map, graphical engine data, or a split screen of any 2), the use of 2 display units provide twice as much viewable data, while at the same time, adding redundancy. This also allows for a simple means to expand your system to meet future avionics needs.

The functions of our GRT are extensive, including major functions such as integrated navigation/attitude displays on the wide-format primary flight display, graphical engine monitoring, moving map, and also including interfaces to the autopilot, localizer and glideslope inputs, with planned growth for weather and traffic.

Clearly the functionality and size is far beyond that provided by other units. The difference in architecture, that is, the ability to use multiple display units independently, vastly distinguishes us from single screen systems. Those familiar with commercial jets may notice a similarity between the architecture (and functionality) our equipment, and that of commercial jets. This is no accident, as the chief engineer's background included 10 years experience in the aerospace industry.

This first level is where the functionality that results in efficient and safe automation of the cockpit is built in.

The Second Level

These differences are more subtle. They include such things as wide-temperature range operation, direct sunlight readability and hardware designed specifically for aircraft use. The design of this hardware is based on

the design principles developed over 12 years of experience with the Engine Information System (EIS) line of engine monitoring and more than 20 years of aerospace experience. This results in a robust design that has excellent tolerance for real-world exposure to wiring errors, radio and electromagnetic fields, etc.

By comparison, other manufactures will use displays not viewable in direct sunlight, or their system may operate only over a limited temperature range, or may be limited by low maximum angular rates, incomplete interfaces, lack of built-in test functions or data validation, and further may operate in "unconventional manners".

This second level is the level where the quality is designed in.

The Third Level

These details are usually unseen, but are what distinguishes aviation equipment from non-aviation equipment. It includes not only the selection of components suitable for use in an aircraft environment, but also relies on a failure modes and effects analysis. This analysis results in design features and functions (such as built-in-test functions) that add integrity. High integrity means a low probability of an undetected failure of any of the flight critical data provided to the pilot.

This third level is the level where safety is designed in.

Conclusion

In the simplest terms, the difference between us and the others is the engineering and flying experience upon which our system is designed. The GRT Sport provides aerospace grade design, at kit plane affordable prices.

What are the limitations of the AHRS?

- When flying close to the magnetic north or south poles, the AHRS must revert to using GPS track data, instead of magnetic heading data. This reduces the integrity of the AHRS calculation of attitude, and the effectiveness of its GPS/AHRS cross-check. The GRT will alert the pilot to this degraded mode of operation. Obviously, this is unlikely to affect most users.
- In theory, it is possible for the AHRS to be affected by vibration, especially if resonances (flexibility) exist in the mounting of the GRT to the airplane. A simple flight test is performed to check for this possibility. We have not seen this problem occur in our testing, but in theory, it is possible.
- The maximum angular rates are 200 degrees/second in roll, pitch, and yaw simultaneously.

What backup instruments are recommended for a single GRT Sport installation?

For VFR flight, the addition of airspeed is suggested.

For IFR flight the Sport ADAHRS replaces the function of the traditional six-pack but does not replace the

redundancy, therefore at least two other attitude sources are recommended. These can include a turn coordinator and autopilot. As well as an airspeed indicator, and altimeter as a minimum, but the pilot should consider their flying skills when configuring their cockpit. For dual electrical bus installations, the EIS can be equipped to serve as a backup airspeed indicator, and altimeter.. This has the added benefit of automatic cross-checking against the GRT Sport's airspeed and altitude.

Why is the GPS database free?

Our database is based on U.S. government data, provided to us at no charge.

Will a database be available for airspace outside of the United States?

Yes. The only difference regarding the database outside of the US is that it will only include airports with runways of 3000 feet or greater.

Can I use a Nav/Com other than a Garmin SL30 with the Sport?

The GRT Sport interfaces with the SL30 exclusively. There are no analog inputs for other radios. You may use other Nav/Com for nav data however you will need a CDI head like a GI106A to show course deviations.

Can I use a low-cost handheld GPS with the GRT Sport?

Yes. Even low-cost GPS receivers include the required NMEA 0183 output.

Are GRT settings user-selectable?

Yes. Practically all data may be displayed in your choice of units, including the barometric pressure setting, temperatures, fuel quantity, etc.

What is the most important feature of the GRT Sport?

The most feature of the GRT Sport is the high integrity AHRS that is not GPS dependent. What good are attitude data, and the GRT, if you can't trust it?

Why doesn't the GRT include an autopilot function?

While it is possible for the GRT to also perform an autopilot function with the addition of a control panel, and appropriate servos, we intentionally choose to interface to stand alone autopilots. A stand-alone autopilot does not use the attitude data from the GRT, and thus is effectively another source of this data. If the autopilot was driven from the GRT attitude data, an undetected failure of this data would result in the autopilot following the bad data. This would make detecting the failure more difficult. While undetected attitude failure is unlikely with our system, the consequences of such a failure are potentially fatal. In effect, the autopilot serves as another source of attitude data, and a good argument could be made for choosing an autopilot over a backup attitude indicator. (A turn coordinator would still be required for IFR flight)

Conversely, with the independent autopilot and GRT attitude combination

we have chosen, a failure of either the autopilot, or the GRT attitude data would result in an obvious disagreement, and could trigger an GRT unusual attitude warning. Safety is greatly enhanced.

Also, autopilot designs are far from trivial. The safety concerns, and control laws which dictate the response of the autopilot require a degree of expertise that we feel is best left to the experts.

Why do you recommend the TruTrak autopilots?

We felt the design of the TruTrak was excellent in terms of safety, and performance. We especially liked the safety considerations in the design of the servos. More obvious to the pilot, the control laws are based on the extensive experience of the designer, Jim Younkin, which result in excellent performance in smooth air or turbulence. In the same way that we have developed extensive experience in instrumentation, TruTrak has extensive experience in autopilots. Other autopilots work well with the Sport also. Some may require a GPS-coupler which converts the digital data to analog used by the autopilot.

What will be your policy on revisions to the software and hardware systems?

Software updates are available via the www.grtavionics.com website at no cost. We do not have a policy for hardware revisions.

Can non-TSO instruments be approved for IFR flight in an experimental aircraft?

Yes.

How often does the GRT update the GPS map?

Our displays are gyro-stabilized, so our map moves smoothly when you turn, no matter how slowly or quickly your GPS updates. Our screens update at high rates, so everything appears smooth on our screens...no jerks or jumps. This makes a significant difference when rolling out to capture a new ground track on the moving maps, as you don't have to guess or anticipate what the map will look like at the next 1 second update..

What provides the land and airspace data (database)?

We have our own database derived from US government databases.

Is the HITS offset on the screen because you are crabbed for wind?

Yes, exactly. It "grows" up and out of the runway, which is obviously a ground-based reference. The primary flight display is shown in **Heading Up** mode, which is the preferred mode, as this makes the view on the GRT match the view out the window. Thus, the difference between the heading up centered display and the ground-based runway guidance is the crab angle. This means that the approach is flown by maneuvering the airplane so that the flight path marker (which represents

your path through space) is centered in the HITS. Even without the flight path marker displayed, interpreting the HITS is very natural, as it is identical to the visual clues you use when you look out the window and fly the airplane to the runway in the presence of a cross-wind. You instinctively develop a sense of the direction of travel of the airplane through space when you look out the window, and the flight path marker is a precise indication of this point. The flight path marker is commonly used on head-up displays in fighter aircraft.

If so, what happens if the wind is stronger - does the HITS go off screen?

It would, except that we apply "display limiting". This means we alter the position of all ground based symbology to keep the HITS and runway on the screen.

What is the sight picture if you are doing a circling approach or a close in base leg?

You see the HITS as though it was a tunnel projected up from the ground. The HITS will not appear on the screen if it is out of view, unless it is out of view due to a strong-cross wind. We will be adding guidance to bring you to the top of the HITS so that we guide you to the vicinity of the airport, and then provide steering to get you to top of the HITS. This is not trivial however.

Does the GRT have a "Quick Erect" function?

No. The only reason to have such a function is if the attitude information was to sometimes become corrupted. The attitude data provided by our system is of very high integrity, and there is no need for a "quick-erect" function. Note that even if the airplane is continuously performing turns and/or aerobatics, the attitude data will remain accurate.

What happens if the AHRS is turned off in flight?

It would be unusual to turn off the AHRS in flight, as it is the primary source of attitude data. If it is turned off, the airplane must be flown as steady as possible for the first 10 seconds after power is re-applied. The plane can then be flown in any manner, and the AHRS will begin providing attitude data within a minute or two.

APPENDIX D: Troubleshooting

The Troubleshooting section gives aid to common installation or use questions.

Terrain

If the GRT Sport is unable to show Terrain data you may see one or more of these flags. This list will help in correcting in the Terrain data being displayed or not.

- **DISABLED** -- Terrain was disabled in the SET MENU but is still selected on the SHOW button.
- **NOT READY** -- The display is busy loading other databases.
- **Waiting for USB** -- The display did not find terrain on a flash card, and is waiting for a USB flash drive to be inserted. A USB flash drive may take up to a minute to be detected.
- **No database** -- A terrain database was not found on any storage device. The display will stop searching until the next boot.
- **Loading** -- The terrain database integrity is being checked and the index is being loaded into memory. The time this requires depends on the size of the database and how busy the display is. The terrain will start up faster while on the Power Up and MAP pages.
- **OK** -- The terrain database has completed loading. Terrain will be drawn and the terrain alarm activated if requested.
- **Low memory** -- Some part of the terrain database was not able to load because the display is low on memory. This message should not normally be seen, but is possible if several memory intense features are all active at the same time. Weather, terrain, large map ranges, and DEMO recording can consume large amounts of memory. The display will attempt to use any parts of the terrain that could be loaded. Report this message to GRT.
- **Bad database** -- The terrain database has been damaged or is not compatible with the display software.
- **ERROR** -- The display has detected a failure in its terrain processing and has disabled all terrain functions. Terrain will not be available until the next boot. Report this message to GRT.

AHRS/Magnetometer-Com Interference

Most problems encountered with attitude or heading after installation is the placement of the AHRS and Magnetometer near ferrous metals or com coax cables. Most of these problems can be avoided if the Installation Guide is followed.

Wire bundles from the AHRS or magnetometer must be kept away from com coax cables. It is suggested to run com coax on one side of the fuselage and AHRS/Mag wire bundles on the other. If the coax must pass by the wire bundles it is suggested that it be made perpendicular to the wire bundle.

See AHRS and Magnetometer Installation Guide for more detail.